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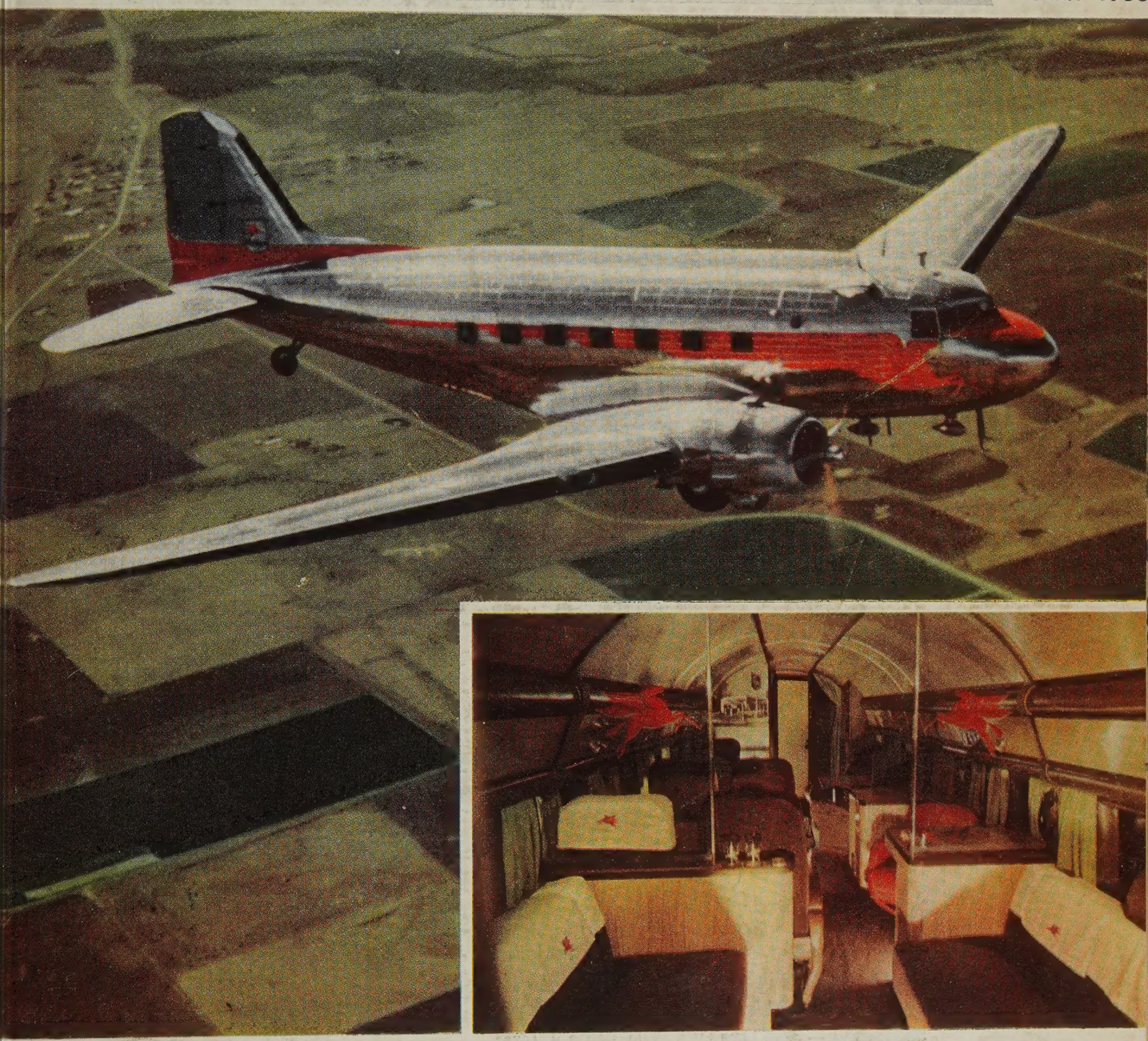
Skyways

Flight Operations • Engineering • Management

MAY 1953



- Executive Pilot's Report: The New Beech Twin-Bonanza
- Round Table: Airborne Radar
- On-The-Spot Sys

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Flight Operations • Engineering • Management

MAY, 1953

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COVER: Magnolia Petroleum Company's DC-3, one of a fleet of 10 business aircraft, averages over 50 flying hours a month as personnel transport.

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VOLUME 12, NUMBER 5

SKYWAYS is published monthly by Skyways Publishing Corporation, 444 Madison Ave., New York 22, N. Y. Advertising Offices: 444 Madison Ave., New York 22, N. Y. Henry, McIntosh & Simpson, West Coast Reps., 816 W. 5th St., Los Angeles 17, Cal., Allen & Rutherford, Mid-West Reps., 230 E. Ohio St., Chicago 11, Ill. Printed in U.S.A. Subscription Prices: U. S. possessions, Canada and Pan-Am. Union $9.00 for 3 years, $7.00 for 2 years, $4.00 for 1 year; all other countries add $1.50 per year for postage. Six weeks required for address changes (give both old and new). Manuscripts, drawings, other material must be accompanied by stamped, self-addressed envelope. SKYWAYS is not responsible for unsolicited materials. Reentered as second-class matter April 16, 1948, at the post office at New York, N. Y., under the act of March 3, 1879.

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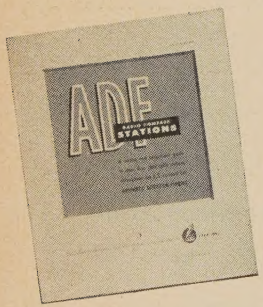

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. . . air your views

ecs for Air Transport

ntlemen:

have been flying for 20 years, have built over 10,000 hours as both a civilian and itary pilot, and am still flying. With your mission I'd like to add a few points to r interesting Flight Operations Round le on the subject of "Specifications for al Corporate Air Transport." I feel that se points should be considered by all de- ners, aircraft and engine manufacturers, l company-plane users.

1. De-Icing Equipment (no boots)
   A. Built in the skin surfaces of the aircraft; electrical heat elements thermostatically controlled.
   B. Voltage: working from 110 volt alternating current inverters while engines are running at approximately 1200 rpm or more.
   C. A.C. or D.C.: convertible to 110 volt direct current while on ground, with electric hook-up to airport facilities (cable reel installed on aircraft).
   D. Control: thermostatic control in all cases would keep all necessary skin surfaces at even temperature of 40°F to 60°F as required to keep ice, snow, frost from sticking to skin in form of a solid.
   E. Combination of units installed with same system: nacelle heating units for oil tanks and engine accessory sections, and possibly for nose and propeller domes.
   F. All inverters should be standardized as to size, capacity and space requirements to permit quick change, and so placed where they can receive cool air circulation for cooling.

Perhaps this sounds like a lot to incorrate into one electrical system, but with oper engineering it is possible.

2. Standardized instrument panel. Get all the instrument manufacturers together to standardize on sizes and mountings so that a rearrangement of instruments is possible without chopping up the panel.
3. Pressurization. This is important, but I wonder if it's good enough. For safety sake, shouldn't oxygen be carried aboard?
4. All-weather flying. This is a "must" for business aircraft, and all cockpits should be designed to permit easy and low-cost installation of new radio and radar devices.

I feel that a staff of designers should be ganized, one designer from each of the jor aircraft and engine companies, and at their work should be financed jointly by aircraft and engine companies and by business concerns interested in operating siness aircraft designed for their needs. ce a design has been approved, a prototype ilt, and after test and approval by the AA, the manufacturers should join forces to build the airplane, thus effecting team work in promoting the use of aircraft as a business tool.

I wonder if the company-plane users are going to be willing to wait 5 or 10 years for the aircraft and engine manufacturers to come out with something that will meet their needs?

CAPT. H. E. MILLS, USAF
6622 Air Transport Sqd.
c/o Postmaster, New York

Three of our largest aircraft companies have displayed interest in the business-plane market, and designs are presently being readied for consideration by the users of aircraft for business.—Ed.

Pilot Service

Gentlemen:

This is probably the first letter I have ever written to any magazine or newspaper, but I feel compelled to express myself for the following reason: it is a common frustrating experience to watch so-called experts in their fields opinionate on many subjects but without ever supplying a real need of any group of readers. Skyways, with its coverage, is supplying just such a need.

The professional and non-professional pilot flying a business airplane on personal or company business always has been at a loss to cope with the problems of flight operations and equipment which you cover so well. Experience is a fine teacher, but an expensive one. The experiences of others engaged in this type of transportation are invaluable in suggesting ways and means of improving operations and effecting safe economies.

I especially wish to commend you for your attention (Navicom) to the problems of airways navigation and communication. No experience is more disturbing than that of arriving in some congested area of the airways on instruments to find some new and complicated procedure or new frequency in use, and have to be made to look like a dope in comparison with the air-carrier pilots who have been thoroughly briefed by their companies who participated in making the changes in the first place. Why do only the airlines and the military get in on it in advance? Thanks to you for keeping us up to date on this change business!

I have talked to many professional non-airline pilots who have told me they are making your magazine as much a part of their pre-flight preparation as their Jep manuals and Airman's Guide, etc. That's service to the public, with a capital S . . . for Skyways.

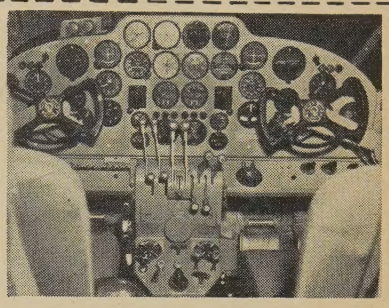
ARTHUR GORDON
New York, N. Y.

Thank you, Sir. We intend to steadily improve our service to all pilots and officials having to do with flight operations, aircraft management, etc., and we welcome suggestions from our readers.—Ed.

EXECUTIVE AIRCRAFT MODIFICATION

BY

TEMCO



CASE HISTORY: #822-109
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1,000 hour check and overhaul. Installed complete new interior, soundproofing cockpit. Designed and installed new instrument panel, overhauled all instruments; relocated radio equipment on TEMCO-fabricated racks, added Omni equipment and replaced all radio wiring. Installed new engines, overhauled all accessories. Painted exterior.

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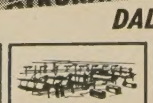

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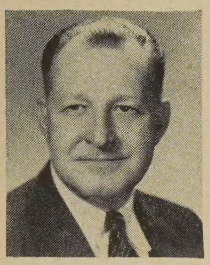
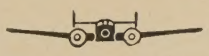


William Littlewood, vice president—engineering of American Airlines, was chosen to deliver the IAS 16th Annual Wright Brothers Lecture in Washington, D. C. An adaptation of that important talk is presented in this issue of *Skyways* under the title, "Trends in Transport Engineering." Mr. Littlewood has been closely connected with the development of transport aircraft in this country, and his talk, blueprinting particular needs for transport development of the future, has been of great interest to people within the industry. Bill Littlewood joined American Airlines in 1930 when it was known as American Airways. He was elected vice president—engineering in 1937. In 1935, Mr. Littlewood was given the Wright Brothers Award, presented annually by the Society of Automotive Engineers for an "outstanding contribution to aviation."



► The Magnolia Petroleum Company DC-3, pictured on the cover, is the Number One executive aircraft of Magnolia's fleet of 10 airplanes used by the company for various business operations, from pipeline patrol to personnel transportation. During the past year, the Magnolia DC-3 averaged over 50 flying hours per month, covering a total of 250,000 land miles in the interest of company business. The transport seats 15 passengers in a beautifully appointed cabin (see inset), plus pilot and copilot; and is powered by two Pratt & Whitney R-1830-75 engines rated at 1350 hp each. The plane has an 8-hour safe cruising range plus a reserve of more than an hour (fuel capacity: 1,000 gallons; each engine burns 55 gallons per hour), and has a normal cruising speed under average conditions of 197 to 200 mph. It is equipped with an A-3 automatic pilot, and dual instruments, electric and vacuum operated from either engine. Radio equipment includes seven radio receivers, three high- and low-frequency transmitters, an interphone and public address system, and a cabin console radio with seven cabin speakers, each with a volume control. The Magnolia DC-3 is one of the best-equipped business aircraft flying the skyways today. In addition to it, Magnolia's fleet includes a Twin-Beech, a new Aero *Commander*, and a Cessna 195 for executive transportation, providing a total seating capacity of 28 passengers plus crews.

► In the realm of aircraft instruments, which gives the pilot the clearest picture—a quantitative or a qualitative indication? Lt. Cmdr. George Hoover offers an answer to this question in his article, "Data Presentation," a follow-up to his first, "Let's Analyze Before We Standardize," in the April issue. Backing up his contention that qualitative information offers the simplest indication to the pilot, Lt. Cmdr. Hoover cites three pilots who were flying the same type aircraft. They were asked to state the actual amount of oil pressure maintained under a normal cruise condition. Two of the pilots reported they couldn't remember the exact amount but thought it was about 80 or 90 lbs., while the third pilot said he wasn't sure of the quantity but that he always knew when he was all right because of the position of the pointer. All of which proved to the author that the numerical value was not what commanded the pilot's attention but rather the arc of the dial in which the pointer was located. On that premise, Lt. Cmdr. Hoover has suggested replacing the numbers on certain instrument faces with condition markings. His article includes illustrations of instruments redesigned to give qualitative indications.

► Next Issue: Radar and its applications to flight operations are a subject of great interest to professional pilots. The use of radar in solving the mid-air collision problem is discussed in the article, "Radar for Collision Warning," by James Q. Brantley, Jr., an engineer associated with the Cornell Aeronautical Laboratory in Buffalo, N. Y.

The Flight Operations Round Table, "Trends in Air Transports," highlights future transport developments to meet the needs of the airlines and business-aircraft operators.

executive pilot's report:

TWIN-BONANZA

Six-place Twin-Bonanza rated A-1 in built-in safety factors and good in both performance and instrument-panel design

by Herb Fisher

From the standpoint of safety and performance, the new *Twin-Bonanza,* soon to be available to the civilian market, is a very satisfactory executive-type aircraft.

Safety was an over-riding consideration in the design conception of this sturdy, aerodynamically clean, six-place transport and the result is an airplane which incorporates more sound safety factors than any other comparable light twin.

Here is a quick run-down of the plane's safety features:

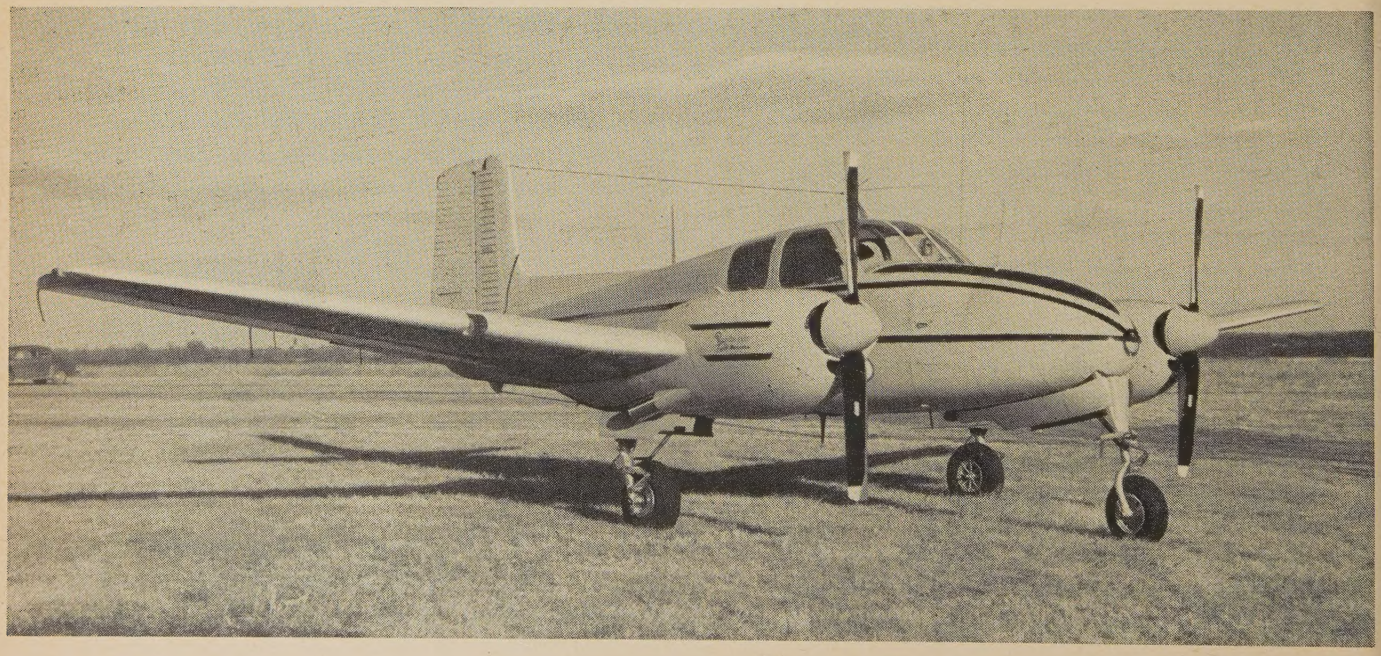
An 8 G flight load factor, which is well above the CAR minimum for aircraft in this category.

More than 60% of total weight is forward and below the passenger compartment.

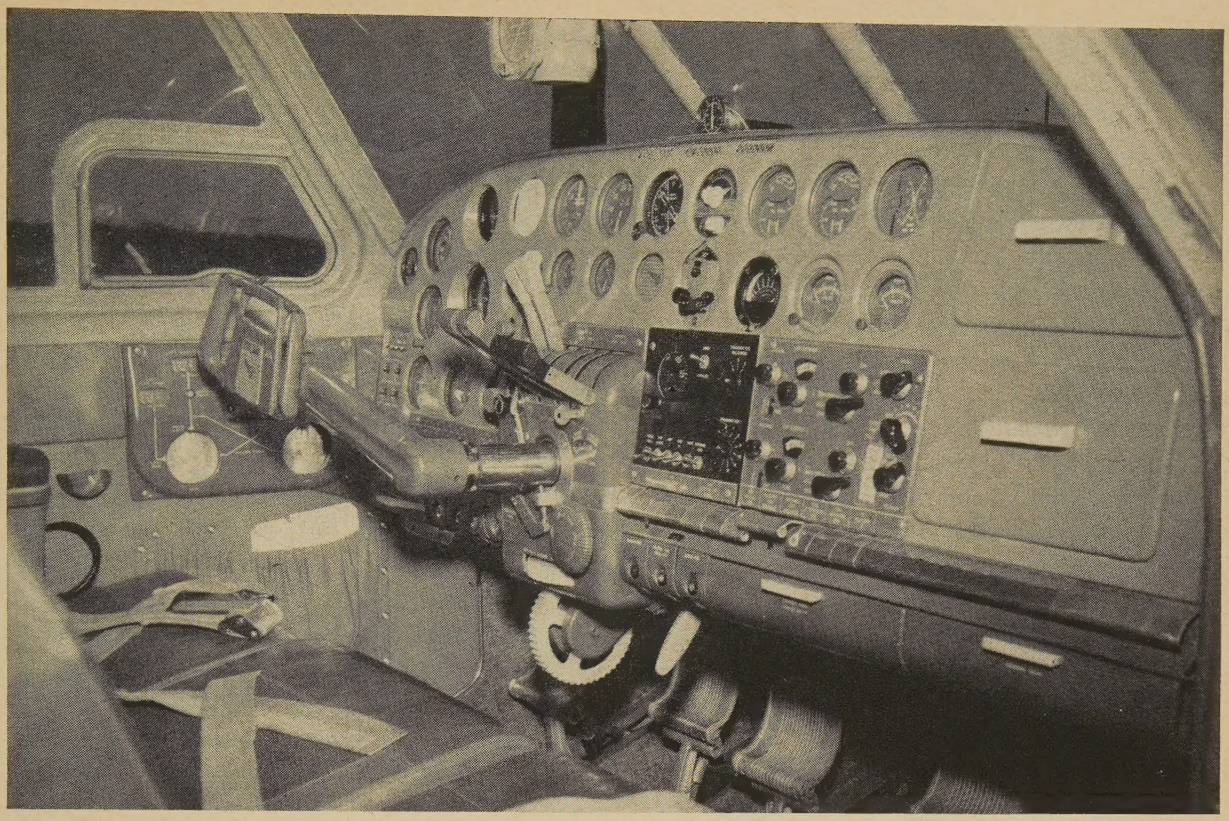
A long nose section built to serve as an impact shock absorption unit.

Increased strength in structural members around the cabin, including a heavy keel to help in minimizing injuries during wheels-up emergency landings.

Wing tanks are situated behind the main spar in the center section and



LYCOMING *engines, each delivering 260 hp at 3400 rpm for take-off, give the Twin-Bonanza good get-up-and-away performance. Efficiency of the Lycomings is increased with the installation of jet augmentation*



INSTRUMENT PANEL *on the Twin-Bonanza is tilted 10° to provide better visibility in reading gauges. Control wheel is curved; will bend, not collapse, on impact*

are surrounded by specially reinforced structure.

Shoulder harness fabricated of Nylon stressed for high G loads. In this connection, the backs of the front seats are well padded.

A direct ventilating system supplied by ram pressure through a nose vent, well away from engine fumes.

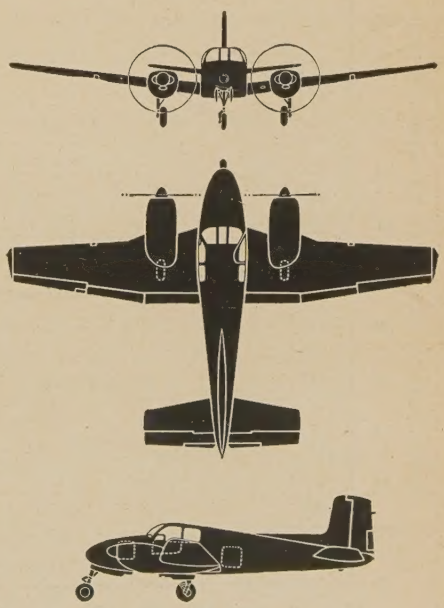
A control wheel of the type recommended by researchers in crash injury investigation. The wheel is curved and bends without collapsing on impact.

There are several other safety features, such as extension of the main gear tires slightly below the fuselage line to provide a cushioning effect in belly landings, but those listed are the major items which together spell out the better-than-average safety characteristics of the *Twin-Bonanza.*

The happy combination of sound aerodynamic design and two of the efficient, dependable Lycoming G0435-C2 six-cylinder, horizontally opposed engines provides highly acceptable performance at maximum gross weight of 5500 lbs. I had become familiar with this powerplant in an earlier twin-engine transport and I can report that it lives up to its fine reputation in this new low-wing Beech.

Before going into detail on performance of this personnel transport, which was purchased off the shelf by the Air Force before civilian production could be launched, I'd like to stack it up against some of the requirements corporate users have laid down for airplanes in the 4- to 6-place classification.

According to a questionaire distributed by the Corporation



Aircraft Owners' Association, 13% of those who replied designated a preference for the 4- to 6-place low-wing airplane with tricycle gear, a cruising speed slightly above 200 mph, good operating radius, and low landing speed.

From my own knowledge and experience, I also know that the corporate user wants such an airplane to be comfortable for passengers, to have a comparatively quiet cabin and to provide good visibility. Ease of maintenance is, of course, always an important requirement. Another important factor is the plane's ability to carry all necessary navigational equipment, adequate fuel, a full load of passengers and their baggage without interfering with CG or the gross weight limitation.

The *Twin-Bonanza* meets the gear, low-wing and range requirements, has a comparatively quiet cabin and is easy to service and maintain. Its cruising speed, however, is well below the 200-mph level specified by some corporate users, although it compares favorably with other twin-engine transports now on the market or on the way.

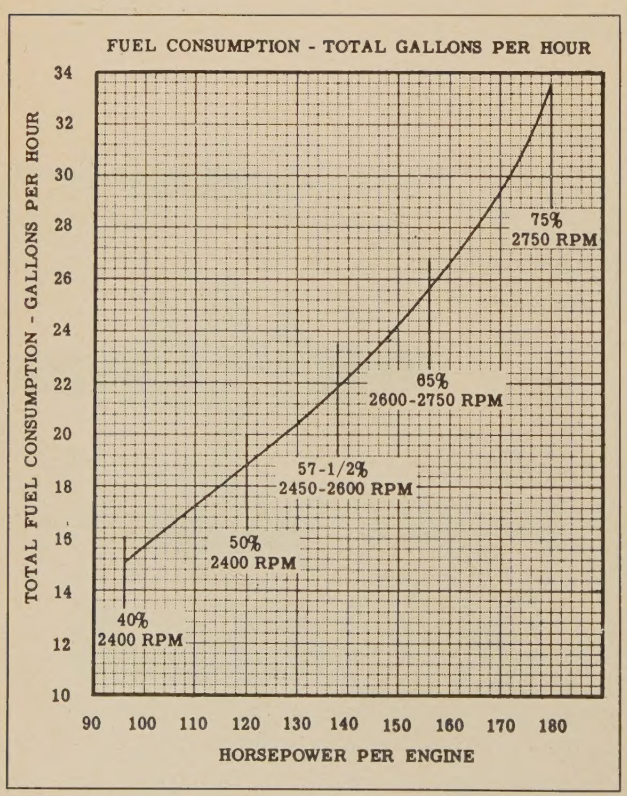
At full gross weight of 5500 lbs., this airplane's best cruising speed is 190 mph at 10,000 ft. and 65% of rated power. Its range at that power setting and altitude, with no reserve, is listed as 975 miles. At maximum gross, 50% power (163 mph) and 10,000 ft., with no reserve, range extends to 1,155 miles.

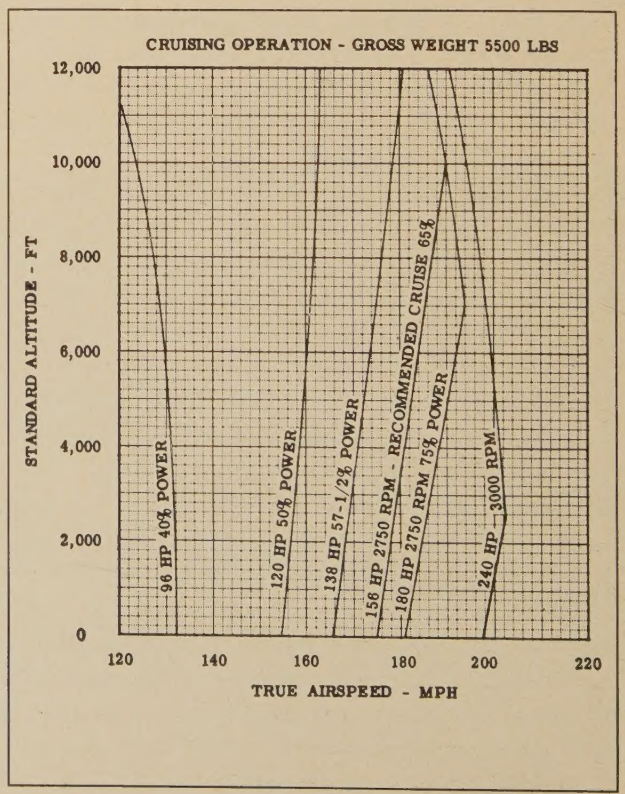
I am not sure I'd like to sit for four or five hours, as a pilot or passenger, in a *Twin-Bonanza* with a full passenger load. The side-by-side seating arrangement does not create a feeling of crowdedness, but once you are in place there is no freedom of movement. In short, you're anchored for the duration of the flight.

While I'm on this problem of passengers, I'd like to point out that climbing into and out of this plane is a real chore and one that was created by the low-wing configuration. It is never easy to climb up two small metal steps, walk the wing and bend down to enter a door, as one must do in entering this airplane. I believe it would be a more difficult chore for a woman. And, although it is a small item, the small section of the door mechanism which protrudes several inches is a definite hazard to clothing. It has torn more than one jacket.

I am convinced, too, that every six-place airplane should have two doors, including one beside and for the benefit of the pilot. This twin has only one and it's on the starboard side, an inconvenience to the pilot.

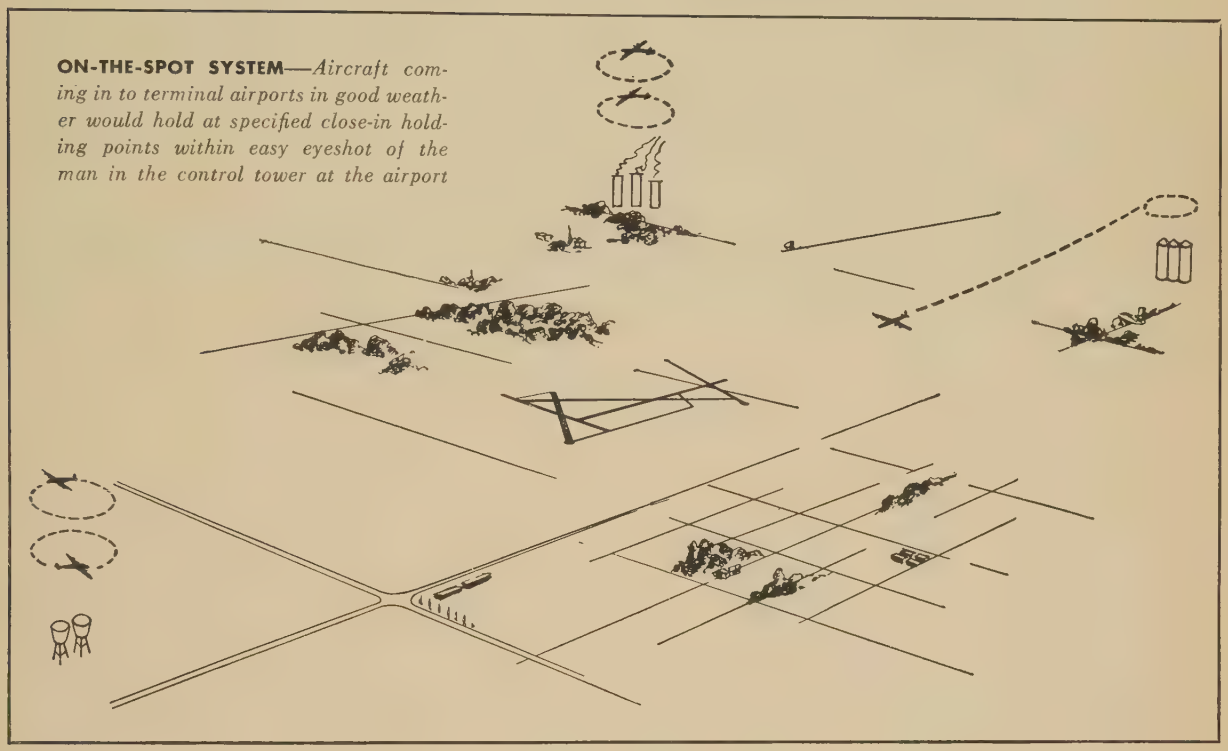
It is my opinion that the useful load of the *Twin-Bonanza*, 1700 lbs., is just low enough to create some problem in a number of possible load situations. At the same time, I am aware that in order to keep to the 5500-lb. gross while *(Continued on page 56)*





by Hiram W. Sheridan
Capt., American Airlines

ON-THE-SPOT ARRIVALS



ON-THE-SPOT SYSTEM—*Aircraft coming in to terminal airports in good weather would hold at specified close-in holding points within easy eyeshot of the man in the control tower at the airport*

The editors, and the author, would like to know what you think of the Spot System as it is proposed in this article. Can you improve on it? Let us hear from you, especially from "the birds in the glass cages."—Ed.

The great tin goddess of the air fanned her way toward one of the busiest airports in the country. The pilots had flown more than 1800 miles but they were relaxed for all that. The weather was good and the great city appeared before them, sparkling in the night like the chest of a dowager. They would soon be home—they hoped.

If you were an angel and were perched somewhere in the cockpit so that you could watch the pilots, you would have been astonished. Of course, an angel would be astonished at a pilot in any case, but that is not the point here. These men by now were not acting in a normal manner.

As they neared the city, they sat forward in their seats, hunched over like a couple of Japanese wrestlers bracing for the shock of combat. Their appearance was not deceiving for they were in fact bracing for the modern aviation game of Blind Man's Bluff, or Dizzy Tizzy.

They knew what was coming and they would have prayed if it would not have interfered with their hearing what the magpie in the tower, the bird in the glass cage, was saying. Not that it mattered whether they did or not—they would be confused anyway. But it is customary to be confused in an official manner, a protocol of the profession, so to speak.

The scrimmage was coming. So were they. Lackaday. Lack a few years if they didn't watch out, for this was one of the busy hours for the huge airport. The swiveled gentry who do what they call "thinking" had figured out something that looked fine on paper, and which may be necessary, too, for crossroads airports. To provide *(Continued on page 52)*

Trends in Transport Engineering

An adaptation of Wright Brothers Lecture delivered in Washington by

William Littlewood, vice president—engineering of American Airlines

Established air transportation in America is a little more than 25 years old. In that time tremendous technological changes and improvements have occurred in air-transport equipment, its performance and use. The purpose of this article is to investigate the trends in the technical aspects of air-transport engineering, to consider the significance and propriety of the directions in which they appear to be leading, and to emphasize some of the problems requiring solution.

If we were to define the modern American air transport, making no reference to variations in size, speed, range, number of engines, etc., it would be a low-wing, all-metal, internally braced, smooth stressed skin structure with two or four conventional engines driving constant-speed, full-feathering, reversible propellers. It would be fitted with retractable tricycle landing gear with various numbers of wheels and brakes dependent on the size of the airplane. The streamlined engine housings or nacelles would in flight effect complete closure over the retracted main wheels. The airplane would have slotted flaps, and the ailerons and tail control surfaces would probably be tab trimmed or controlled and would be metal covered. The cockpit would be fitted for a minimum crew of two, with at least one more for the large four-engine types; would contain somewhat standardized communication, navigation and control equipment of many types; and for the medium and longer ranges, the entire fuselage would be pressurized, tended by a suitable cabin crew, and fitted with comfortable reclining seats, lavatories and suitable food accommodations. The airplane, powerplants, propellers, etc., would be fitted with ice protection, generally of the heat type.

But with all this indicated standardization and excellence, there remains much to be done in the engineering field.

I sincerely hope the future holds no threat of change in basic type from the low-wing, all-metal air transport. Many studies have been made and proposals offered suggesting high-wing designs, but to my way of thinking, the points in favor of high-wing design do not begin to balance out the safety and economic advantages of the low-wing type.

There are two popular arguments in favor of high-wing airplanes. One is that the passengers can see the ground better; the other is that the floor is closer to the ground, thus making the airplane easier to load and unload. Comparative studies have shown some weight advantage in favor of the low-wing, primarily because of the shortened landing gear and the elimination of keel and supplementary structure necessary to achieve the minimum required fuselage strength forward, but the irrefutable advantage of low-wing design lies in the area of safety. The disposition of passengers in a high-wing aircraft between the mass concentration of engine, wing and fuel weight, and the probable point of impact with the ground in the event of a crash landing, is almost

METEOROLOGICAL APPROACH *is only answer thus far to complete avoidance of hail such as caused this damage*

TURBOPROP TRANSPORT *would seem to meet needs of short-haul domestic air carriers. Indications are, however, that jet powerplants will reach desired point of reliability for transport operations before turboprop powerplant does*

certain to result in aggravated casualties.

One of the best ways to absorb the energy of impact is to permit the destruction of structure. How much better it is to have that structure—not the fuselage in which the passengers are housed but rather the wings and engine installations.

Another significant aspect of passenger cabin safety is associated with the provisions for getting in and out of the aircraft. This is most important in event of an emergency. Regulation specifies an aft location for emergency exits. However, actual experiences contradict the conclusions that airplanes always terminate crash landings facing forward; they end up with their axes at all angles with the line of initial impact from 0° to 180°. It is the writer's strong opinion that the normal entry doors to the cabin are of more value than any other emergency exit because of passenger familiarity as to location and use.

I would also like to open a strong case for standardized and improved locations, designs, directions of opening and hinging, and types of latches, handles and operating instructions for passenger doors of all descriptions. In my opinion, these factors are as fundamental to evacuation safety as any other consideration. The entire question of emergency evacuation merits much thought and engineering study.

Engineering thinking must also recognize the impossibility of expecting service mechanics to cope adequately with the unknown. We cannot assume that a service mechanic always has a Maintenance Manual at his elbow, nor that he has the time or inclination to look up every subject remotely related to his particular problem. There have been many instances of mechanics unwittingly drilling through a blind floor or bulkhead into a congested mass of unprotected electrical cables or conduits. A little forethought would indicate that an airplane should be marked in such a way that, without reference to a Manual, the mechanic would know that there were items of equipment behind any critical location on a floor or bulkhead. This type of engineering thinking is the only guaranteed preventive of innumerable accidents and mishaps.

All too often details of thoughtless design or installation engineering are discovered as the causes of incidents and accidents, *i.e.*, hinge pins that fall out; latches that become inoperative and unlatched; leading edge covers that hinge on the wrong side and come dangerously loose in flight; or in the less dangerous but equally annoying category, faucets that will not shut off; outboard drains that freeze; valves and controls that lock from low temperatures; equipment items that come loose in turbulence. These are but a few of hundreds of details which challenge the quality and capacity of air-transport design engineering.

Designed for Ground Handling

We could also list innumerable factors, affecting ground-handling characteristics, which are worthy of note. It seems obvious that if our airplane is to be larger than present aircraft, it will accommodate more passengers, and for safety, as well as convenience, careful consideration must be given to the number, size and location of entry-exit doors, as well as to the accommodation of passengers on the ground. It is amazing that throughout the years airline passengers have endured the exposure and inconvenience of transition through all kinds of weather between the passenger ramp and the airplane cabin. It now seems that as our airplanes become larger and more difficult to handle and as our passengers continually increase in total number and group sizes, we should give careful thought to a change from the principle of bringing the airplane to the terminal building, to stationing the airplane at a convenient ground maneuvering and servicing location and conveying the passengers and their baggage to the airplane by suitable ground vehicles.

Communications

Speaking of existing complexity and the necessity for simplification in our future airplanes, I would like to emphasize the situation with respect to electronics. A DC-6B airplane has among its electronic equipment two HF radio transmitter-receivers, one VHF transmitter-receiver, one automatic DF, one glide slope receiver, one radio altimeter, one autopilot possibly with its black box ILS coupler, one marker beacon receiver, two omnirange receivers and one intercommunication system. Other aircraft of the same type may also have a Loran receiver, electronic propeller controls for governing and synchronizing, electrical supercharger controls for pressurization superchargers or for engine boost; and if we look to the future, we will probably have electrically operated fuel regulators, more complex engine-propeller controls, radar equipment, etc.

A DC-6B as now equipped has at least 350 vacuum tubes. The average life of a vacuum tube in service is estimated to be 5,000 hours. So, you can see the extreme vulnerability to electrical trouble and expense of modern and future transport airplanes. We do have now in development and available to a limited degree, transistors and associated units which are expected to increase reliability of the electrical devices by many times—currently estimated as 15 times and ultimately 100 times. They will, of course, eventually save weight and space and promote economy. It is hoped they will greatly reduce the cooling problems of high-power electronic equipment, which is one of the main causes of tube unreliability.

The program of miniaturization includes development of transistors, capacitors, resistors and dielectrics by the use of new materials and techniques. However, it will require a long time to find its way into practical benefits of weight and space saving in the aircraft. The units must be developed to be satisfactory functional types, after which they must be applied to commercial electronic units and thereafter installed in the aircraft with significant changes of location and installation. It is impossible to achieve overnight the benefits of such a required chain of events, but we will eventually have them. Miniaturization also involves the application of the midget principle to instrumentation and other functional units where size and weight can be reduced without affecting efficiency or reliability. This whole program is a highly beneficial one headed in the right direction. The significance and importance of the increasing penalties due to the addition of new units of equipment or increase in size complexity of existing units is receiving much attention, as was emphasized by Ed Heinemann's recent discussion of the growth factor in military airplanes. He used a figure of 10 to 1 as the ratio of the total penalty applying to equipment weight increases. It is easy to see the significance of some such number, even though we may disagree as to its absolute value in affecting the efficiency and cost of transport aircraft.

In the past we have tried to develop nice, clean, aerodynamically efficient transport airplanes, and have usually ended up by plastering them all over with antenna, radomes and gadgets until we had paid a very significant penalty in performance. Dr. Harald Schutz of the Glenn L. Martin Company recently mentioned among future developments in the antenna field (1) all flush-mounted antenna; (2) novel radiation devices such as corrugated surfaces and dielectric slabs; (3) the use, as radiation sources, of apertures such as jet intakes; (4) the use of conductive fluids in plastic canopies; (5) the use of ionized exhaust gases as radiators. Hopefully we will have no external protuberances on our future aircraft except those required for the basic aerodynamic or thrust producing properties of the vehicle.

Development of Future Transports

Assuming that we have defined our modern transport type, and by imaginative, analytical engineer-

CHARTS *timetable trends in air transports from 1926 to present time, by Lockheed, Douglas, Consolidated Vultee*

ing have improved its quality, let's examine a few of the problems which face the next series of high-performance aircraft when they come into being.

The great emphasis which the military program has placed on jet development will bring that simpler type of powerplant to a satisfactory and reliable condition long before we can hope to have turboprop operations. In the American domestic picture there appears to be a bracket of requiring ranges, roughly from 500 to 2500 miles, and appropriate sizes of well-developed jets to give us an efficient transport airplane of quite high performance and satisfactory economy. Below these bracket ranges, however, there would still seem to be the need for turboprop powerplants.

From the airline point of view, it is obviously undesirable to operate more models of aircraft than are necessary to perform the required service. Smaller airlines may continue to do their work with one model. However, in the domestic industry and among the larger airlines, a minimum of two models will be required.

There has been much discussion in the feederline field concerning the specifications for an efficient small transport airplane offering greater economy than the DC-3. Presumably, its engineering characteristics would not be too much different. It might operate with less field requirement; it might have better single-engine performance and reserve; and it might possess better flying qualities, but it would need little, if any, more in the way of speed or altitude performance. However, it must offer all this and still be much more economical per unit.

In the larger domestic airline picture, development of two current types—the *Stratocruiser, Constellation* and DC-6 for medium to long-range operations, and the Convair 240 and 340 and Martin 404 for short-range operations—probably will continue in use.

With respect to the medium and long-range domestic aircraft, it is fairly clear that reasonable increases in size, coupled with the economic benefits to be achieved from high-altitude, high-speed operation, can permit the early development of transports built around proven and efficient jet engines.

Transport Noise Problem

We are currently faced with a serious transport noise problem, not noise in *(Continued on page 58)*

LOCKHEED TRANSPORTS

MODEL	CERTIFICATION DATE	PURPOSE	GROSS WEIGHT	TYPE	POWER PLANT	SPEED HIGH	SPEED CRUISING	ULTIMATE RANGE-MI	CONSTRUCTION & MATERIALS	REMARKS
ACTIVE VEGA	1926 & 1929	P-4-6 M-21 C.F.	3470 TO 4500	HIGH WING MONO	1-W-J5 OR 1 P&W WASP	190	172	660	MOLDED PLYWOOD	FIXED GEAR PROPS-ADJUSTABLE
ORION	1930	P-6 M-18 C.F.	5400	LOW WING MONO	1 P&W WASP	227	205	720	"	RG PROPS-CONTROLLABLE
ELECTRA L-10	1933	P-10 C-800#	10,500	LOW WING MONO	2 P&W WASP JR	202	156	880	AL ALLOY INTERNALLY BRACED	RG PROPS-C S
L-12A	1935	P-6 C-865#	9200	LOW WING MONO	2 P&W WASP JR	223	168	850	"	RG PROPS-C S
L-14H	1937	P-11 C-2700#	17,500	MID WING MONO	2 P&W HORNET	244	187	2060	"	RG PROPS-C S
LODESTAR L-18	1939	P-14 C-3400#	17,500	MID WING MONO	2 P&W HORNET	240	180	1875	"	RG PROPS-C S
CONSTELLATION L-049	1939	P-51 C-14,250	86,250	LOW WING MONO	4 WRIGHT 3350	340	199	5000	"	PR-RG PROPS-F F C S
L-749	1945	P-44 C-13,500	102,000	LOW WING MONO	4 WRIGHT 3350	346	215	5430	"	PR-RG PROPS-F F C S R
L-1049	1950	P-75 C-13,120	120,000	LOW WING MONO	4 WRIGHT 3350	333	236	5300	"	PR-RG PROPS-F F C S R
L-1049E	1950	P-63 C-13,860	133,000	LOW WING MONO	4 WRIGHT COMPOUND	362	259	4930	"	PR-RG PROPS-F F C S R
INACTIVE EXCALIBER (L-44)	1939	P-21 C-3500 CF	27,500	LOW WING MONO	4 P&W WASP	241	180	2180	"	RG PROPS-C S
SATURN L-75	1944	P-14 C-1450#	16,000	HIGH WING MONO	2 W-1820 CYCLONE	252	189	2040	"	RG PROPS-F F C S
CONSTITUTION L-89	1943	P-168 C-34,109	184,000	MID WING MONO	4 P&W 4360	307	227	1900	"	RG PROPS-F F C S

M-MAIL P-PASSENGERS RG-RETRACTABLE GEAR FFCSR-FULL FEATHERING CONSTANT SPEED REVERSE
C-CARGO (LBS) CF-CUBIC FEET PR-PRESSURIZED FFCS-FULL FEATHERING CONSTANT SPEED W-WRIGHT

DOUGLAS TRANSPORTS

ACTIVE MODEL	CERTIFICATION DATE	PURPOSE	GROSS WEIGHT	TYPE	POWER PLANT	SPEED HIGH	SPEED CRUISING	ULTIMATE RANGE-MI	CONSTRUCTION & MATERIALS	REMARKS
M-1-2-3	1926	MAIL	4,968	BIPLANE	1 LIBERTY	145	110	650	TUBING-TIE ROD FUSELAGE - SPRUCE & WOOD WINGS-FABRIC COVERED	FIXED LANDING GEAR - WOOD PROPELLER
C-1	1925	U.S. TROOP TRANSPT	—	BIPLANE	1 LIBERTY 12	121	—	—	"	"
DC-1	1933	P-12-18 CARGO-1000 LBS.	17,500	LOW WING MONOPLANE LAND	2-W-1820 F	210	190	1000	GENERALLY 24S INTERNALLY BRACED	RETRACTABLE L.G. H.S.-3 BLADE-HYDROMATIC C.S
DC-2	1934	P-14 CARGO-1740 LBS.	18,560	"	"	"	200	1060	"	"
DC-3	1936	P-21-24 (14 DST)	25,200	"	2 P&W 1830 OR W 1820 G	211	191	1480	"	"
DC-4 (C-54)	(1943)-46	P-44 CARGO-5138 LBS.	73,000	"	4 P&W R-2000	234	219	4240	"	"
DC-6	1947	P-52-68B CARGO-7320 LBS.	93,100	"	4 P&W R-2800	350	304	3370	GENERALLY 24S INTERNALLY BRACED +75S	RETRACTABLE L.G. PRESSURIZED 4 C.W. OR H.S. FFCSR PROPS
DC-6A	1951	CARGO 30,150 LBS.	107,000	"	"	370	315	3400	"	RETRACTABLE L.G. PRESSURIZED 4 H.S. FFCSR PROPS
DC-6B	1951	P-66D C-11,930 LBS.	100,000	"	4 P&W R2800 CB16	371	315	3720	"	"
DC-7	1953	P-69D C-13,980 LBS	122,000	"	4-W 3350 COMP	393	360	4445	" + T	"

P-PASSENGER P&W-PRATT & WHITNEY FFCSR-FULL FEATHERING CONSTANT SPEED REVERSE DST-SLEEPER
C-CARGO H.S.-HAMILTON STANDARD COMP-COMPOUND ENGINES T-TITANIUM D-DAYPLANE
W-WRIGHT C.W.-CURTISS WRIGHT CS-CONSTANT SPEED L.G.-LANDING GEAR

DOUGLAS TRANSPORTS

INACTIVE MODEL	CERTIFICATION DATE	PURPOSE	GROSS WEIGHT	TYPE	POWER PLANT	SPEED HIGH	SPEED CRUISING	ULTIMATE RANGE-MI	CONSTRUCTION & MATERIALS	REMARKS
DC-4E	1939	P+C FUSELAGE SPACE INCOMPLETED	65,000	LOW WING MONOPLANE LAND	4 P&W R-2800	242	200	1750	GENERALLY 24S INTERNALLY BRACED	1 ONLY EXPERIMENTAL (ABANDONED)
DC-5A	1940	P-22 CARGO-3000 LBS	23,500	"	2-W-1820 H	265	241	1165	"	11 ONLY EXPERIMENTAL (ABANDONED)
DC-7 (OLD)	1946	P-CARGO-11000 LBS	162,000	"	4 P&W 4360	306	262	5000	"	(ABANDONED)
DC-8 (OLD)	1947	P-38-48 CARGO-1000 TO 6000 LBS.	39,500	LOW WING MONOPLANE LAND (PUSHER)	2-V-1710 ALLISON	290	270	—	"	EXPERIMENTAL (ABANDONED) 3 BLADE CONTRA ROTATING PROPELLERS
DC-9	1948	P-28 CARGO-3500 LBS	31,445	LOW WING MONOPLANE LAND	2-W-1820 (2 SPEED)	—	258	2590	"	EXPERIMENTAL (ABANDONED) 2 C.W. ELECTRIC PROPELLERS
SUPER DC-3	1950	P-31 C-3030 LBS.	31,000	"	2-W-1820C -9H	270	250	2200	"	2 H.S. FULL FEATHERING PROPS

P-PASSENGER P&W-PRATT & WHITNEY
C-CARGO H.S.-HAMILTON STANDARD
W-WRIGHT C.W.-CURTISS WRIGHT

CONSOLIDATED-VULTEE TRANSPORTS

MODEL	CERTIFICATION DATE	PURPOSE	GROSS WEIGHT	TYPE	POWER PLANT	SPEED HIGH	SPEED CRUISING	ULTIMATE RANGE-MI	CONSTRUCTION & MATERIALS	REMARKS
ACTIVE COMMODORE	1929	P-20 75 CU.FT.	17,600	HIGH WING MONO B.OAT	2 P&W HORNET	128	108	1000	ALUMINUM ALLOY & FABRIC WING ALUMINUM HULL	BOAT
FLEETSTER	1931	P-6 60 CU.FT.	5,900	HIGH WING MONO LAND	1 P&W HORNET B	180	153	750	PLYWOOD FUSELAGE-ALUMINUM WING & TAIL	FIXED PITCH PROPELLER FIXED GEAR
VULTEE V1A	1934	P-8 C-1600 LBS.	8,500	LOW WING MONO LAND	WRIGHT 1820 RF2	235	215	—	ALUMINUM MONOCOQUE	RETRACTABLE GEAR 1 ADJUSTABLE PROPELLER
PBY-5A	1945	P-22	28,000	HIGH WING MONO AMPHIBIAN	2 P&W 1830	195	139	750	ALUMINUM ALLOY-FABRIC COVERED CONTROLS	MILITARY CONVERSION
240	1947	P-40 CARGO-3000 LBS.	41,790	LOW WING MONO LAND	2 P&W R-2800	326	291	1620	ALUMINUM ALLOY	RETRACTABLE-TRICYCLE GEAR H.S. OR C.W. F F C S R
340	1952	P-44 CARGO-3600 LBS.	47,000	LOW WING MONO LAND	2 P&W R-2800-CB-16	317	284	1830	ALUMINUM ALLOY	RETRACTABLE-TRICYCLE GEAR H.S. OR C.W. F F C S R
INACTIVE 39	1942	P-48 CARGO-12,600 LBS.	66,500	HIGH WING MONO LAND	4 P&W R-2000	300	240	3300	ALUMINUM ALLOY	EXPER ONLY-RETRACTABLE-TRICYCLE GEAR
110	1944-45	P-30 C-2080 LBS.	36,000	LOW WING MONO LAND	2 P&W R-2800	314	270	1250	ALUMINUM ALLOY	EXPER ONLY-RETRACTABLE-TRICYCLE GEAR
C-99	1943	P-204 OR 100,000#	328,000	MID WING MONO LAND	6 P&W R-4360	299	235	4750	ALUMINUM ALLOY	EXPERIMENTAL ONLY 2 DECKS

P-PASSENGER P&W-PRATT & WHITNEY FFCS-FULL FEATHERING CONSTANT SPEED
C-CARGO H.S.-HAMILTON STANDARD FFCSR-FULL FEATHERING CONSTANT SPEED REVERSE
MONO-MONOPLANE EXPER-EXPERIMENTAL

DATA PRESENTATION

Which is best—Qualitative or Quantitative indications in the cockpit? Pilots queried stated preference for qualitative indications

by George W. Hoover
Lt. Cmdr., USN

The science of data presentation poses many complex problems. One of the more important of these is the determination of whether to use quantitative or qualitative indication. When a function of a machine requires instrumentation, it is general practice to indicate the necessary data in terms of that function. In other words, if oil pressure is the function, the indication is usually given in pounds pressure since this is the term which engineers have prescribed to measure that function. To the engineer this is a necessary factor within the over-all operational equation. To the operator, however, this is only one more numerical value which he must memorize in order to determine the condition of operation. The actual quantity is of little consequence to the operator except to use it as an index.

Three pilots who were flying the same type aircraft were asked to state the actual amount of oil pressure maintained under normal cruise conditions. Two of them remarked that they couldn't remember the exact amount, but that it was about 80 or 90 pounds. The third pilot indicated that he wasn't sure of the quantity, but that he always knew when it was all right because of the position of the pointer. It would appear from this that the numerical value was not primarily what these pilots noticed, but rather the arc of the dial in which the pointer was located.

Some steps have been made to simplify the indication of this function. The oil pressure indicator in a standard automobile, for instance, is similar to those used in aircraft, but relatively few drivers take the time to memorize the range of oil pressure normal to the engine. Very few drivers would notice if the pressure were to drop below normal. In some automobiles, this type of indicator has been replaced by a red light which is illuminated only when the pressure is incorrect. When the light appears, there is no question as to whether or not the oil pressure is the correct amount; it obviously isn't, so the next step is to find the nearest service station.

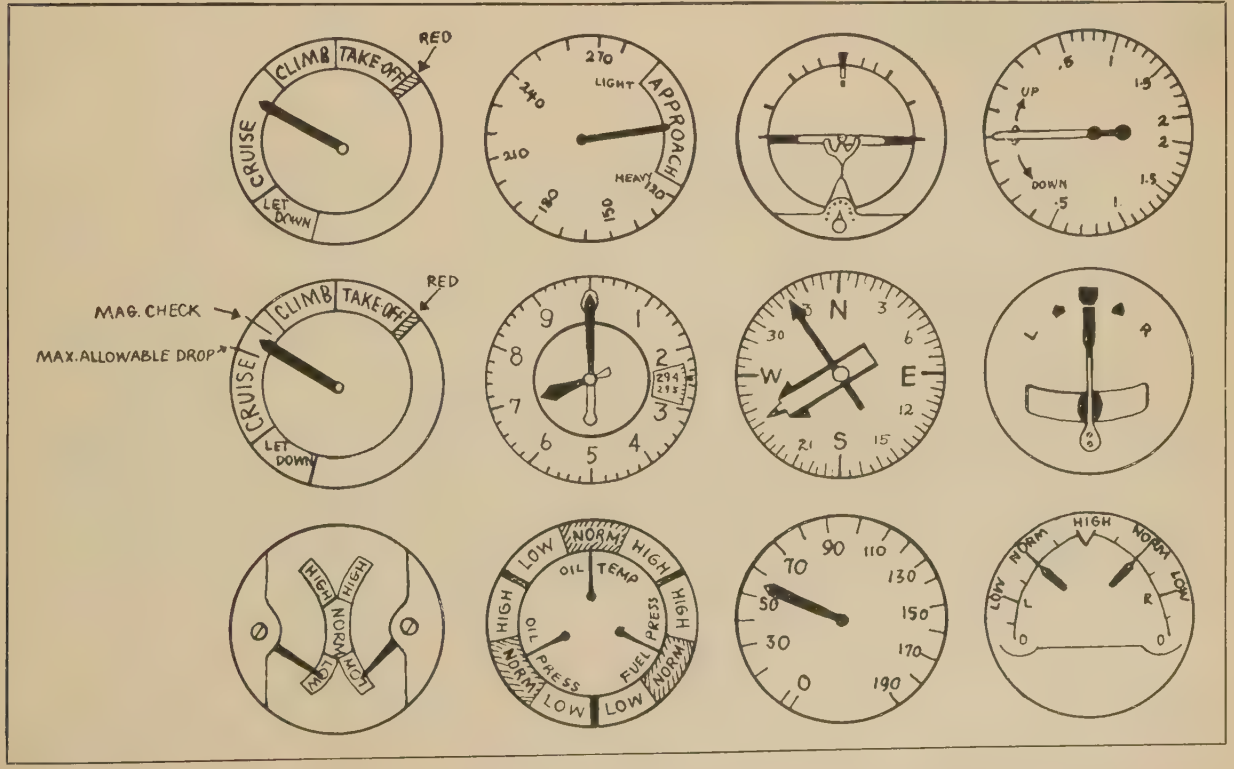
This is not meant to advocate the use of red lights in place of pressure gauges, but rather to point out the use of qualitative indication when a numerical value is not required. A high-low-normal gauge or one marked in red and green areas would do the job just as well as a red light. At any rate, the driver would not be required to remember some arbitrary number.

Of the many instruments now being used, some could be simplified by replacing the numbers with appropriate condition markings. In some cases they might even be replaced by a go-no-go type of indication. At a recent discussion of cockpit arrangement by pilots and engineers, the question arose as to the necessity for a voltmeter and an ammeter. One participant claimed that the voltmeter should be eliminated and the ammeter be retained. His opponent set down just the opposite requirement. Actually they were each half right. Both instruments could be eliminated and replaced by an indicator showing the range of operating output of the generators. Very few pilots know the actual voltage and current values of the generators and basically what they need to know is not how much voltage and current, but rather how well the generators are operating.

Now the argument will be made that since some kind of indication is required, why not make it quantitative as well as qualitative. The counter argument is simply that *(Continued on page 58)*

STANDARD GAUGES *(above) require pilot to memorize certain values re. RPM and manifold for various conditions; airspeeds for cruise, approach, landing, etc.; oil, fuel pressures; oil, cylinder head, carburetor air temperatures*

MODIFIED GAUGES *(below) suggested by the author would give pilot qualitative indications and he would not have to memorize numbers. Only numbers to be concerned about would be those relating to flight factors, i.e. heading, etc.*



SKYWAYS FLIGHT OPERATIONS ROUND TABLE

MAY, 1953

Wings Club, New York, N. Y.

AIRBORNE RADAR

Discussion indicates best feature of airborne radar is its ability to provide weather information in cockpit; terrain-clearance feature rates second; navigational use is third

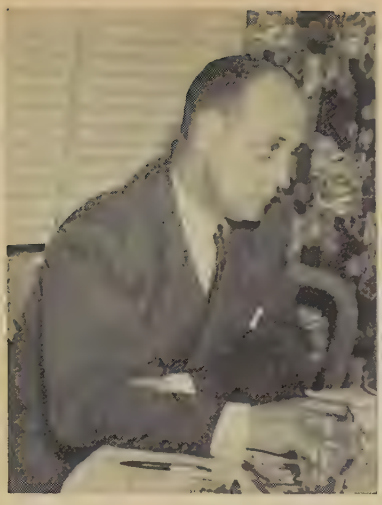
SAM SAINT, *Director of the Air Navigation Traffic Control Division of the Air Transport Association, is an active airline pilot. Prior to his present assignment, Mr. Saint was manager of Air Navigation and Traffic Control Development for American Airlines. He is based in Washington.*

Sam P. Saint *(Dir., ANTC Div., ATA):* "The subject of airborne radar is one of growing interest to many people in the air transport industry today. Nearly everyone knows in a general way the important part that has been played in our past military operations, by radar carried in the airplane itself, and many people have asked why radar is not carried in our commercial transports today. We're here to discuss the problems associated with airborne radar and to find out what airborne radar will do for us.

"Gathered around this table we have a total of 174 years of experience in aviation and electronics. With this much experience, we should be able to arrive at some reasonable answers as to what airborne radar will and will not do, and what problems stand in the way of putting airborne radar to work in our flying machines.

"Before getting into the discussion, it might be useful to the readers of this Round Table discussion to start with a thumbnail description of an airborne radar. With your permission, I'll attempt this myself. A radar is a device that throws out very short bursts of radio energy which we call 'pulses', and these pulses of radio energy are bounced back or reflected back to the aircraft by the rocks on a hillside, or the water droplets in a storm cloud, or perhaps the surface of another airplane. The resultant echo is displayed to the pilot on a screen, known as a radarscope, in the aircraft. The echo appears on the scope 'picture' at the proper azimuth and distance from the aircraft. The aircraft is normally in the middle of the picture flying up the scope.

"While we're talking about the actual machinery, would someone explain the relationship between the size of an airborne radar antenna and the width of the beam that is transmitted? Will one of you technical people discuss this angle of the problem? Bill Parnell of Westinghouse Electric, how would you like to?"



"COST *of 3.2-cm radar will be less per unit than the 5- or 6-cm radar at this phase of radar design and development," according to General Electric's Owen K. Lindley*

ROUND-TABLE *warm-up opportunity came before the meeting when Eastern Air Lines J.J. George and American's A.F. Merewether, Capital's J.D. Smith and Sam Saint got together*

"PILOT *of a plane equipped with airborne radar," stated William Carnes, "can get some good out of radar right away, without having to wait for other planes to be equipped"*

"RADAR, *although it does not directly portray turbulence associated with a storm, does indirectly give a good indication of the turbulence," according to A.F. Merewether*

"RADARSCOPE *must be sufficiently arrestive," warned E.S. Willey of BOAC, "to command the attention of a pilot who is already busy in the cockpit of today's fast planes"*

"COLLISION *information on the scope in the cockpit could be clarified," stated William Parnell of Westinghouse, "by means of a mechanical or electrical antenna tilt control"*

WILLIAM S. PARNELL, *Design Project Engineer for Westinghouse, has been directly connected with development of airborne radar systems for the past seven years. He joined Westinghouse in early '39.*

CAPT. R. D. FORDYCE *has been with Pan American since 1935. He served as Asst. Chief Pilot, Technical, 1945 to 1950; as operations manager, Avianca, in 1951. He is presently flying transatlantic routes.*

Limitations Require Compromises

William S. Parnell *(Design Project Engr., Westinghouse Electric Corp.):* "The width of the transmitted beam is inversely proportional to both the antenna reflector diameter and the frequency of the transmitter. As the diameter of the reflector on the frequency increases, the beam width becomes narrower."

Sam Saint: *"Then, to get a narrower beam, which means higher effective power and greater definition, you need either a larger reflector (or antenna) or you go to a higher frequency. Obviously, the size of the antenna will be limited by practical considerations. It seems appropriate to ask, then, is there any factor that limits the use of higher frequencies? Gen. Joe George, I wonder if you would expound on the relation of frequency to the radar's ability to penetrate rain."*

Joseph J. George *(Supt. Meteorology, Eastern Air Lines, Atlanta Municipal Airport):* "When the wave length is down around 3 cm., the beam penetration is much less through a typical rain cloud than if you increased the frequency to 10 cm. The attenuation is great in a 3-cm radar, whereas it's quite small in a 10-cm radar. I think that's the principal difference."

Sam Saint: *"That's the point I wanted to bring out here. Namely, that we're having to make certain compromises. If the frequency of the radar is too high, we get very fine definition in the picture but the radar will not see far enough through rain to be useful to us."*

Cole H. Morrow *(Chief Plant Engr., J.I. Case Co., and CAOA):* "In airborne radar, doesn't the physical size of the aircraft, which finally resolves itself into the physical size of the antenna that could be put aboard that aircraft, place a limitation immediately on where you can go in this frequency range or beam width that we've been talking about? In other words, regardless of how desirable it might be, you couldn't put a 40-foot antenna on board an aircraft, and doesn't that place an immediate limitation on what frequency can be used and the quality of radar presentation obtained?"

Sam Saint: *"Yes, I think we are forced to work within fairly narrow limits in both antenna size and frequency. It might be well to establish what these limits are before leaving the technical aspects."*

Cole H. Morrow: "We're talking about 3-cm and 10-cm wave lengths. Is it physically possible to use 3-cm or 10-cm antennas in airborne equipment?"

Sam Saint: *"Bill Carnes, will you take up that question?"*

William T. Carnes, Jr., *(Mgr., Electronics Engr'g., Aeronautical Radio, Inc.):* "That's one of the points on which we have to do some compromising, as you pointed out before. We have made some studies and some of the airframe manufacturers are cooperating with us in determining just what can be done physically on aircraft at the present date and on future aircraft, and I would conclude that a 30-inch antenna is perfectly possible on almost any airplane we know of today, *if* we're willing to pay for it. The cost of every inch of antenna size can be pretty high. Whether a 30-inch antenna is economically practical or not is another matter which each customer will have to decide for himself. But our studies show that even an airplane the size of a Convair 340 can utilize a 30-inch dish if we wish."

Cole H. Morrow: "One of the reasons I brought

CAPT. J. D. SMITH, *a Capital Airlines pilot, is also chairman of Regional Safety Committee of the Air Line Pilots Association. Capt. Smith began flying in 1938, and has accumulated some 10,000 hours.*

OWEN K. LINDLEY *joined General Electric Co. in 1929. He was assigned to Electronics Division in 1942, and is today Sales Manager of Special Products for Commercial Equipment Dept. of GE.*

E. S. WILLEY *was Chief Navigator on BOAC Technical Development Flight for a year; joined BOAC's Operations Branch in 1949. He undertook preparatory work in Far East for Comet route to Tokyo.*

JOSEPH J. GEORGE, *Superintendent of Meteorology for Eastern Air Lines, joined EAL in 1934; spent 4 years with Air Force (1942-46), was separated as Colonel, promoted to Brig. Gen. AF Reserve, '49.*

this question up is in consideration of new aircraft, and the possible future utilization of airborne radar. I wanted to clear up the point so that we can include in the design-specifications of such an aircraft, the provisions for whatever size antenna is required."

Storm Detection

Sam Saint: "*Thanks, Cole, your point demonstrates the value of these round-table discussions. We get the various phases of the problem into proper perspective.*

"*Now let's consider the use of airborne radar to detect and avoid thunderstorms and certain other weather phenomena that pilots (and passengers) don't like.*

"*Capt. Bob Fordyce, how urgently do you think we need a device in the airplane which will let the pilot dodge the core of a well-developed thunderstorm?*"

Capt. R. D. Fordyce *(Pan American World Airways):* "I'd say that largely depends upon the area you fly or where you intend to operate the aircraft. It depends on the degree of frequency and the severity of the storms. You have fairly extreme and numerous thunderstorms in the southwest United States, while in the North Atlantic thunderstorms are not much of a problem. When we operated the APS-10 (a military airborne radar of World War II) for about a year, we found several uses for it, but we were always a little puzzled in being able to justify the equipment from the point of view of cost. I'd say there's a definite need for airborne radar, but it depends more or less on how much you want to pay to get it."

Sam Saint: "*Bob, would you care to comment on the difference between what the airline passengers would like and what pilots need?*"

Capt. R. D. Fordyce: "From the point of view of the passengers, I'd say it would be a very substantial inducement, perhaps to an even greater extent than it would be to the pilots, but again, that depends on the amount of turbulence anticipated in the area through which a given airline may be operating."

Sam Saint: "*Maybe we should mention here a fact that is known to all of us, but may not be known to all* Skyways *readers. An airborne radar will see the precipitation in a thunderstorm and present this picture to the pilot in a form which will let him navigate around the storm regardless of whether or not he can see the thunderstorm out of the window.*"

Cole H. Morrow: "In the interest of clarification, Sam, I think it would be well if somebody would put on the record the relation of precipitation with respect to turbulence, etc., in thunderstorms."

Sam Saint: "*That's a good suggestion. Let's get Col. Merewether of American Airlines to go into that.*"

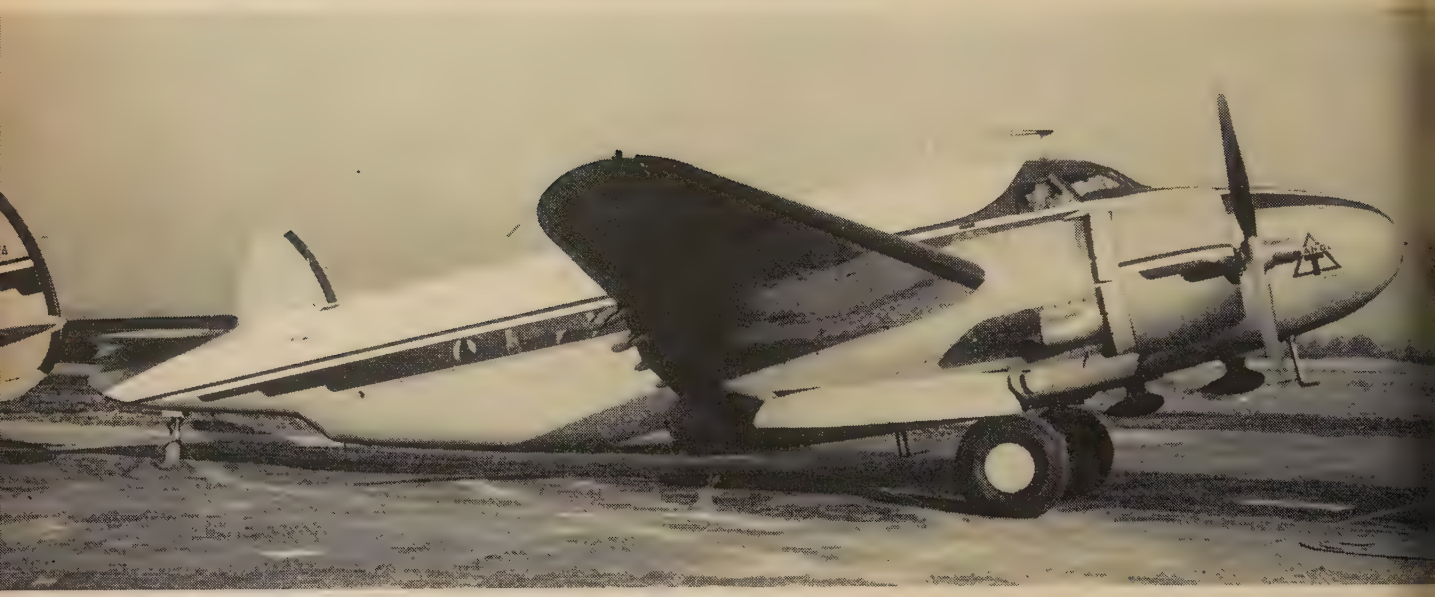
A. F. Merewether *(Supv., Meteorology, American Airlines):* "In a thunderstorm you have vertical currents which tend to hold the droplets up in the atmosphere to the point where you get a considerable concentration of droplets which reflect the energy. Of course, it's the up and down currents in the atmosphere which tend to give you your turbulence. So, although radar does not directly portray the turbulence associated with the storm, it does indirectly give a very good indication of the turbulence that is associated with any particular storm by the character of the echo received from the rain drops or snowflakes. *(Continued on page 36)*

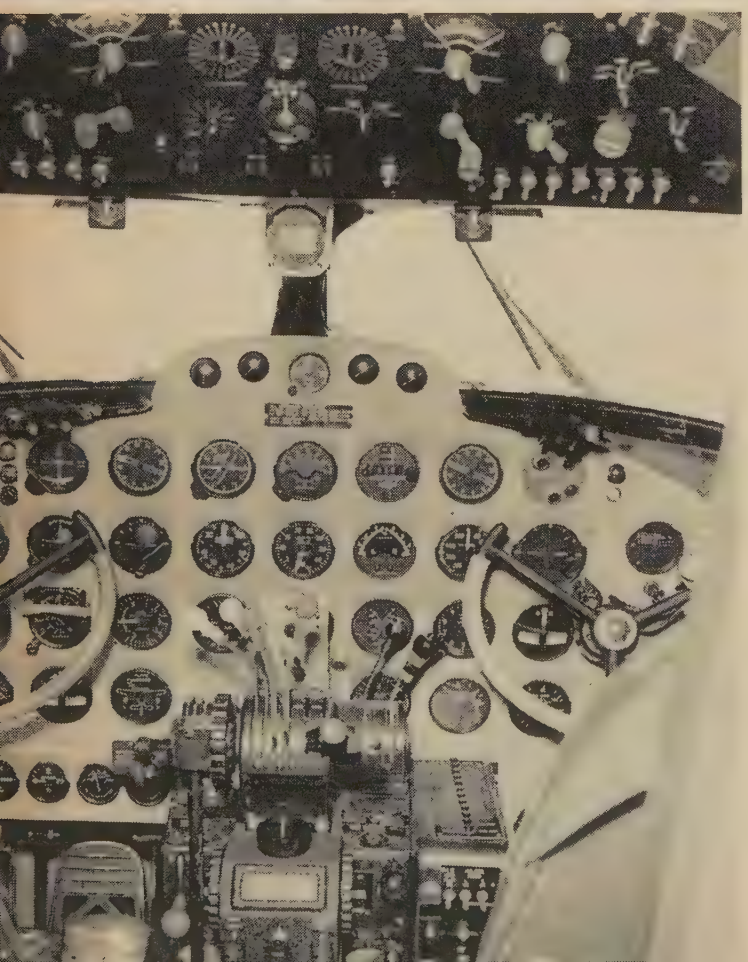
WM. T. CARNES, JR., *Manager, Electronic Engineering, ARINC, is also Chairman, Airlines Electronic Engineering Committee. Prior to joining ARINC, he was superintendent, radio engineering, for TWA.*

A. F. MEREWETHER *has been Supervisor of Meteorology, American Airlines, since 1946. He was an Air Force pilot from 1929 to '46, and served as Chief, Weather Service, for the U.S. Air Force, 1939-'42.*

executive conversion

TRIANGLE PV-1





LOCKHEED PV-1 *was converted for executive use for Triangle Conduit & Cable by Aero Trades in 1951. It and D18S are based at Morristown, N. J.*

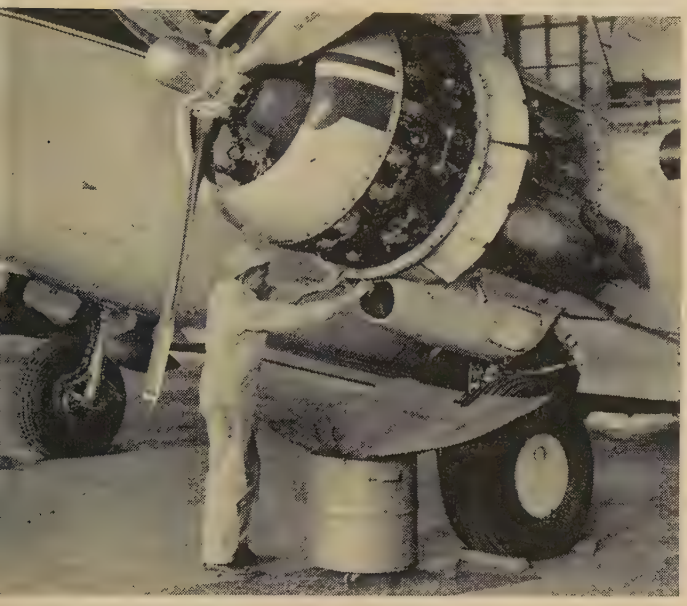
Triangle Conduit & Cable Co., Inc., of New Brunswick, New Jersey, owns and operates a Twin-Beech and a Lockheed PV-1 as executive air transports in the interest of business. Both planes are based at Morristown, N. J.

The Lockheed PV-1 was converted for Triangle by Aero Trades at MacArthur Field in November, 1951. All its windows are oversize and it is believed to have been one of the first PV's to carry two large picture windows. The passenger compartment is completely soundproofed, and it features indirect lighting and seats that not only swivel and recline but can also be moved sideways.

Interior of the plane is done in grey fabric, with the walls below the window lined in a

COCKPIT *of the Triangle PV-1 features a Zero Reader, an A-12, plus all VHF and omni equipment. Larry Lacey is Chief Pilot for Triangle*

MAINTENANCE DOOR *on left side of PV-1, just forward of cockpit, features built-in steps, eliminating need for tall and shaky ladders*



OIL *is definitely not good for tires, so line serviceman John Budd drains oil into an oil drum. Note shield that protects tire from oil*

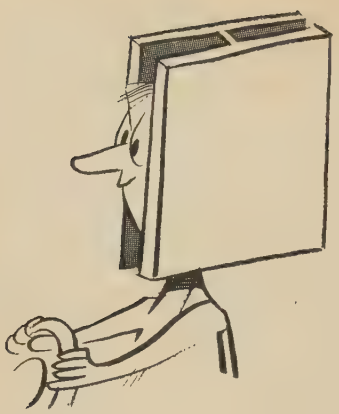
quilted grey plastic. The plane seats eight passengers comfortably.

The pilots' front office is equipped with Zero Reader, the A-12, and complete VHF and Omni. The instrument panel is painted grey which is said to help in readability of the gages. A large maintenance door is located on the left side of the plane, forward of the pilots' cockpit. Steps are built into the door, thus eliminating the need for tall ladders.

Larry Lacey is Chief Pilot and in charge of all aircraft operations for Triangle. His co-pilot is Norman Grady, and both men also fly Triangles' other aircraft, the Twin-Beech.

Triangle Conduit & Cable Co., Inc. hold membership in Corporation Aircraft Owners Assn.

CABIN *of the Triangle PV-1 seats eight passengers comfortably in swivel and reclining chairs, spacious divan. Cabin is sound-proofed*



Performance

from the Files of the Flight Safety Foundation

Gust Locks

A number (too many) of fatal accidents have occurred because:

1. Gust locks were not removed or released prior to take-off.
2. Pilot did not check controls by moving them through full range prior to take-off.

Some new airplanes have clever arrangements which make it impossible to push throttles ahead for take-off without first releasing gust locks. This too can be a trap to the over-confident pilot because ice, as well as many other conditions of which he is not aware, can lock the controls. The following is from our bulletin of September 18, 1947:—

"A pilot checking controls at take-off found ailerons and rudder free, elevator locked. Gust locks were off. Ice had formed on a pulley forming part of gust lock, locking elevator."

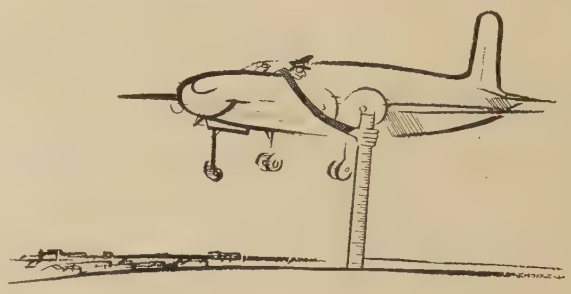
Trim tab position should also be checked prior to take-off because tabs in extreme wrong positions on take-off can affect a captain's disposition!

Gadgetry is helpful, but personal attention to detail can never be eliminated.

ILS

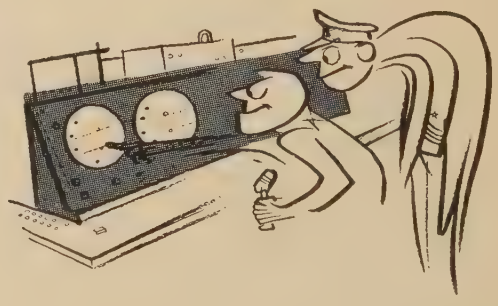
An air transport came in too low (hence, short) on an ILS approach. Luckily it resulted in an incident instead of an accident. Lessons learned:—

1. That the final altimeter setting received by a flight prior to landing be repeated back to the ground station. Steps should be taken to provide the altimeter settings just prior to final approach.



2. That a complete study be made in an attempt to eliminate, insofar as possible, errors in ground and aircraft altimeters.

3. That flight personnel visit towers and GCA to familiarize pilots with approach control and radar surveillance.



4. That every effort be made to modify and improve the present instrument check now given to pilots. Special emphasis should be placed on ILS and GCA work.

5. That steps be taken to establish a standard phraseology for GCA "assists".

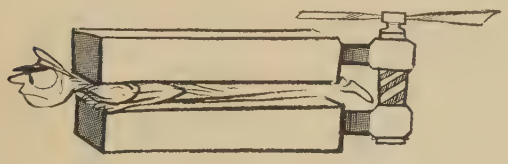
6. That all aircraft be completely de-pressurized prior to starting final instrument approach when on manual control.

PITFALLS

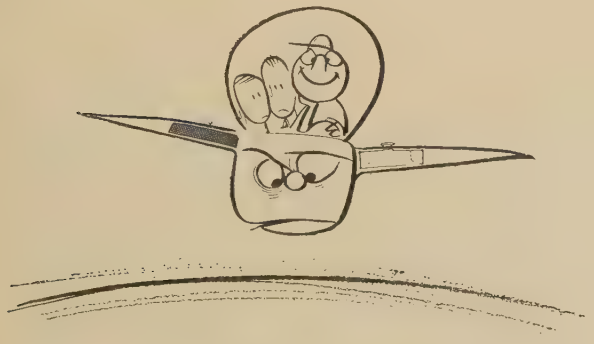
by Jerome Lederer and Robert Osborn

"Pressure" Flying

1. A pilot with two passengers in a lightplane left an airport in Kentucky for Toronto via Toledo, Ohio.



The Toledo stop was for the purpose of refueling and clearing customs. The customs delay was 1½ hours. The pilot, in his haste to get off in order to get his employer to Toronto before dark, failed to check the fuel tanks. Overtaken by darkness and about 25 miles before reaching Toronto, he checked the tank gauges prior to switching tanks. One tank showed empty. Checking the gasoline receipt, he



saw that only the left tank had been topped, with just four gallons added. With visibility down to 2½ miles due to smoke and haze, he was unable to locate the airport when reaching Toronto and had to make an emergency landing quickly before running out of fuel. He advised he was heading away from the city. The aircraft was extensively damaged in the landing, but very fortunately the passengers escaped without injury.

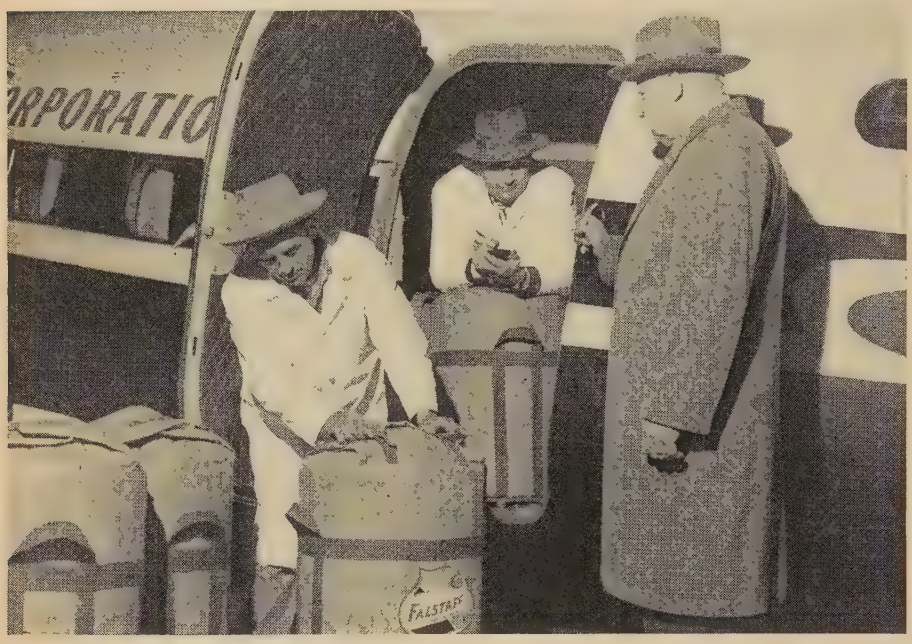
2. In gusty air the pilot who flies a plane containing an accumulation of loose articles such as cushions, earphones, maps, flashlights, etc., may find himself in the position of the fellow who tries a hand stand with his pockets full of rocks. It is hard on the head.

Before every flight, be sure to check the interior of the cockpit or cabin for loose objects.

3. Save your tires to keep 'em rolling to keep 'em flying.

a. Be sure your brakes are properly adjusted.
b. Avoid excessive use of brakes.
c. Do not lock one wheel while turning.
d. Be sure your tires are properly inflated.
e. Do not make abrupt turns.
f. Insist that the airport manager keeps runway and taxi strips free of all rocks and other obstructions likely to damage the tires.

SKYWAYS FOR BUSINESS



FALSTAFF *man loads yeast shipment aboard company plane for flight to San Jose, Calif. U. C. Gramsch, chief chemist (inside plane), chats with L. J. Walther, vice pres., before take-off*

Brewing Corp. Uses Company Plane to Fly Yeast to Calif.

St. Louis, Mo. Using its own company airplane, the Falstaff Brewing Corporation recently flew a shipment of yeast from one of its St. Louis plants to its newly acquired plant at San Jose, California. Problems in shipping the yeast, aside from guarding it against contamination that would result from exposure to air, were to keep the yeast cool enough under refrigeration (not over 34°) to prevent excessive cell action, and warm enough (not below 28°) to avoid freezing which would weaken or kill the cells.

The containers of yeast were packed in dry ice and put aboard the plane early in the morning. Mr. U. C. Gramsch, chief chemist, converted the company-plane galley into a laboratory and kept close vigil on the shipment of yeast during the entire trip.

The plane reached its destination with its refrigerated cargo in a "perfect state of preservation," marking another successful and important use of a company plane.

Crop Spraying Attachment for Cessna Developed by Whitaker

Vancouver, Wash. A new crop-spraying attachment for Cessna aircraft has been developed and CAA-approved. This new unit, the result of two years of work and testing on the part of its designer and builder, Art Whitaker, utilizes the patented I-C-D dispersal units and eliminates pumps, screens, nozzles, relief valves and complicated plumbing. Its two external tanks have a capacity of 86 gallons. The spray pattern is reported to be highly satisfactory, with an application of one-half to 10 gallons per acre and a wide variety of particle sizes. The volume of application is controlled in flight. Either of the two dispersal units may be operated independently, reducing the swath width and effecting a savings in chemicals. An instantaneous release permits emergency dumping.

This crop-spraying attachment has been CAA-approved not only under the usual Part 08 but also 03, and allows passengers to be carried legally without removal of the equipment, except for fans and dispersal brushes (a five-minute operation). The interior of the Cessna cabin is not disturbed other than the addition of the dispersal control system. The unit is available through Cessna dealers and can be readily installed by any Cessna service organization. A letter to the Art Whitaker plant at Pearson Airpark, Vancouver, Washington, will bring further details.

New Distributors Named for Aero Commander in Canada and Kansas

Oklahoma City, Okla. Aero Design and Engineering Co., builder of the Aero *Commander* executive airplane, has announced the appointment of two new distributors for its twin-engine business aircraft.

The Babb Company (Canada) Ltd. has been awarded the franchise for Aero *Commander* sales and service throughout Canada. A general sales office will be maintained at Montreal Airport, and the service and repair facilities for the eastern part of Canada will be set up at St. Johns, Quebec, by Aircraft Industries of Canada, Ltd. In addition a district office will be established at Calgary (Alberta) to handle sales and service for the western section of Canada.

EXTERNAL TANKS *of the newly developed spraying attachment for Cessna aircraft have capacity of 86 gallons. Note the 170's tandem-wheel landing gear for rough field operation*

PILOT *Larry (Poddy) Parish, here at ols of Lodestar he flies for Trinity Drill- Co., is one of southwest's most popular pany plane skippers. He's based at SAC*

e Harte Flying Service, Inc., of Hutchin- Kansas, also has been named distributor he Aero *Commander* for the State of as and the western half of Missouri. Al- gh his service is now located in Hutchin- George Harte has announced that he move to the new Wichita Municipal ort as soon as it is completed. A hangar Harte Flying Service use is now under ruction at the Wichita airport. In ad- n to handling sales in the Kansas, rn Missouri area, Harte will provide plete servicing in his service and modi- ion shops.

cautions Recommended in dling Oxygen Equipment

ncaster, N. Y. Scott Aviation Corpora- has issued a Special Bulletin to em- ize the necessity for certain precautions handling and using any high-pressure en equipment. The following precautions recommended:

lways turn oxygen valve on very slowly.

ake all possible precautions to exclude ny foreign material (especially oil, ease, lint, dust, etc.,) from oxygen linders or valves, and from the high- essure portion of oxygen regulators.

tore oxygen cylinders (and regulators if onnected to a charged cylinder) in a cool lace. Protect from sunlight or other ex- rnal heat.

ismantle regulators at periodic intervals; ean thoroughly and replace any parts hich, because of contamination, cor- sion, abrasion or other abnormal con- itions, have become susceptible to igni- on. The period between overhauls will epend on the usage of the equipment. or average operations, a two-year period ould suffice. Where the usage is frequent questionable, a one-year period would crease safety.

se dry "Aviators Breathing Oxygen" ther than commercial oxygen which con- ins moisture and might cause corrosion.

reful observance of these recommenda- will materially reduce the possibility of gulator fire, Scott Aviation states.

. . . in the Corporate Hangar

Jones & Laughlin Steel Corp. Lockheed 18 is flying again after 100-hour inspection and tank seal repairs by Lockheed Aircraft Service—International at N.Y. International Airport.

Warren Gray, pilot for Hydraulic Press Co., has had the company Twin Beech in the Roscoe Turner Aeronautical Corp. hangar for installation of a Lear L-2 autopilot, an ARC 15D omni and two ARC T-11 transmitters. A new type lighted overhead master radio panel also was installed.

Magnolia Pipe Line Company's Aero *Commander* is back in operation after installation of a Flite-Tronics MB-3 marker beacon receiver. Work was done by Clover Field Radio Supply Co. at Santa Monica, Calif.

Holley Carburetor Company's DC-3 has been in the shop at the Greenville Division of Temco Aircraft Corp. for 100-hour inspection, a RATO installation, a new radio installation, and interior re-arrangement and overhaul. Called "The Chief," the DC-3 was flown to Greenville by Pilot O.E. Sparks.

Lloyd Santmeyer, chief pilot for Allegheny-Ludlum Steel, brought his company's *Lodestar* N-42013 to Lockheed Aircraft Service, Burbank, Calif., for fuel tank sealing and other services.

Lee Traynor has Monsanto Chemical's DC-3 back in the air after 100-hour inspection at Mallard Industries' Bridgeport base. The DC-3's wing attach angles also were checked and some of its control surfaces recovered.

CAA pilots Merrill Morgan and T. Hutchins brought the CAA's C-54 to Grand Central Aircraft's Glendale, Calif., shops for a tank seal, a 1,000-hour inspection and a new paint job.

R. J. McVicar and J. A. Sefsik, Chief Pilot and Chief Engineer for British American Oil Company, Ltd., Toronto, flew their company's *Lodestar* to Butler Aviation at Chicago Midway Airport for hydraulic system, landing gear and instrument overhaul, and for installation of a flasher system, Fenwall Fire detectors, and dual cylinder head temperature.

Capt. Bill Brethwaite, former Chief Pilot for Whiz Chemical, Camden, N.J., is out of the Air Force and planning to return to Elko, Nevada, to reorganize his Veterans Air Cargo Lines. Bill owned and operated this cargo service prior to his return to Active Duty with the Air Force.

Pratt & Whitney is operating its new Convair 340 after interior modifications by AiResearch Aviation Service, Los Angeles. L. Snow, manager of P&W's Airport department, and Walt Pager, also of the Airport department, made the trip to the West Coast with Pilot Ralph Borucson, Copilot Pete Snyder, and Flight Engineer Ronnie Officer, Jr.

Don Beeler, chief pilot for the Delhi Oil Corporation, has his DC-3 at Associated Radio Co., Dallas, for installation of new Collins radio equipment, including the Integrated Flight System. When this work is completed on the DC-3, Bill Powell will bring Delhi Oil's *Lodestar* in for similar radio installation.

A Lockheed *Lodestar* owned by Johnson & Johnson, Summit, N.J., is back in service after maintenance work at Grand Central Aircraft's Glendale plant. Ken Unger flew the ship in for Johnson & Johnson.

Cliff Conrad and Don Butler, pilot and copilot of Pan-Am Southern's Twin Beech, brought the D18S to Associated Radio for a complete radio installation.

Pinky Grimes, chief pilot for Stokely Van Camp, Inc., of Indianapolis, had his Twin Beech in the hangar at Roscoe Turner Aeronautical for installation of a Collins 180-channel transmitter and receiver.

CAOA report

CORPORATION AIRCRAFT OWNERS ASSOCIATION, INC.

Corporation Aircraft Owners Association is a non-profit organization designed to promote the aviation interests of the members firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable corporation aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. CAOA headquarters are located at 1029 Vermont Ave., N. W. Washington 5, D.C. Phone: National 8-0804.

CAA to Guard New Frequency

Increased safety through greatly improved air/ground communications has been made possible through the use of a new frequency at all CAA facilities.

All CAA control towers and communications stations have established a listening watch on 3023.5 kc. which will ultimately replace the presently used 3105 kc. This new ruling became effective March 15.

Use of the new frequency eliminates interference from tropical broadcasting stations and other sources that have made it difficult for CAA towers and communications stations to give good service in many parts of the country.

CAA facilities will continue to guard 3105 kc. for one year after implementation of the new channel. The listening watch on military frequency 4495 kc. was discontinued by CAA facilities on March 16. This allowed 48 hours for equipment changes in military aircraft for use of the new frequency.

The change from 3105 kc. to 3023.5 is but one step in a world-wide program which involves rearrangement of almost the entire high-frequency spectrum, as planned by the International Administrative Aeronautical Radio Conference and approved by the U.S. Government.

The program is designed to make use of all frequencies more effective by eliminating or reducing to a minimum interference from both co-channel and adjacent channel users. The over-all plan will benefit aviation and pilots by providing for the first time in history, exclusive frequencies for aeronautical use.

ARINC Proposes Need for Micro-wave Frequencies

Aeronautical Radio, Inc., representing the airline industry, recently filed a statement with the Federal Communications Commission covering the main points of testimony which it hopes to present later in the theater-television microwave allocation case. Earlier ARINC filed a notice of intent to intervene in the case, which may lead to the reallocation of microwave frequencies—those ranging from about 1,000 to 13,000 megacycles being under consideration at this time.

At present there is no clear allocation of these frequencies for the purposes proposed by Aeronautical Radio, such as telephone, teletype and reservation links. ARINC has outlined the expanding needs which indicate microwave equipment is a real future requirement for air-transport operations and must be anticipated and planned for now. The FCC hearing in the theater-television case has been under way for some time.

Briefly refined, microwave signals are short radio waves which travel in straight lines and thus require repeater or booster stations at about 30-mile intervals for long-range transmission. With these repeater stations, it is claimed, microwave equipment can transmit over thousands of miles. It is said to be far less expensive than wire line communications when more than four channels are involved, since microwave equipment uses no wires between transmitting towers and is free of many of the hazards of storms which interrupt or hamper other type communications.

Designed for Business Use

A new twin-engine pressurized-cabin executive transport to meet the needs of the operators of business aircraft is being readied by Aeronca Aircraft Corp., Middletown, Ohio. The plane is a high-wing transport powered by two Wright R-1820 engines rated at 1525 hp with water injection. Performance calls for landing within 2200 ft. over a 50-ft. obstacle, a cruising speed of 306 mph and a single-engine ceiling of 20,000 ft. Wing span is 63 ft. 4 in. The pressurized cabin is to be custom designed and will accommodate eight persons.

Prototype of the new aircraft is under construction at Middletown, under the supervision of its designer George A. Page, and will be ready to fly in 1954.

Executive-Pilot Course Established

In recognition of the tremendous growth of business flying during the past few years, an 18 month Executive Pilot Flying Course has just been announced by the Embry-Riddle International School of Aviation, Miami, Florida. The graduate will qualify for a commercial pilot certificate with instrument and multi-engine ratings. The applicant must have two years of college or equivalent and is given an aptitude test upon enrollment. The subjects covered in the course will provide the necessary technical and administrative background required for piloting business aircraft.

Usefulness of CAA Radio Aids to VFR Flight

Once in a while, it seems wise to pause and review some of the aviation developments that are proving so helpful in our day-to-day flying. One item that might be of interest is the usefulness of CAA radio aids to flight under VFR conditions.

The navigational aids now supplied by the CAA benefit all types of traffic; general, military, and scheduled carrier, without regard to types of operation. The aids are for the purpose of increasing the usefulness of the airplane.

Federal radio aids to air navigation are provided in a descending order of need, to yield an optimum return on the investment, as reflected by increased usefulness. Within the bounds of a sound economic structure, the ideal air navigation system would interconnect and supply service to all locations having a demonstrated need for more frequent and more reliable service, and with increasing disregard of weather conditions.

It is recognized that radio communication and navigation aids are very useful during good weather conditions, even though their use is required by CAR only during IFR weather conditions. Although no statistics are available, the presumption that greater numbers of aircraft use the CAA navigational aids during VFR weather conditions than during IFR weather conditions is supported by the fact that there is a greater volume of traffic during VFR weather. However, the greater amount of use during VFR conditions does not, of itself, mean that the system is of more value under VFR conditions than under IFR.

The Civil Air Regulations impose no mandatory requirements for radio equipment in aircraft (other than scheduled carrier aircraft) operating under VFR conditions, and there is practical requirement for radio guidance under many conditions of VFR flight. Under other conditions of VFR flight, the presence of radio aids is very desirable, but the absence of radio aid does not, in itself, prevent completion of the flight in uncongested areas. Under IFR conditions, however, both the regulations and the practical problems of flight definitely require two-way communications and radio navigational assistance when accomplishing flight on the civil airways. Two-way radio is required under VFR for landing and take-off at certain crowded airports. It is probable that communication and radio navigational aids will become mandatory in dense traffic terminal areas under what are now considered marginal VFR conditions.

It may be helpful to compare airways with highways. Roads were originally paved to lift the automobile out of the mud and thereby increase the usefulness of the new transport vehicle. The roads first paved were the ones which yielded the most return on the investment. Having been paved, roads are given more use in fair weather than they are in foul. The passenger car does not require paved roads to be of use in dry weather, but paved roads certainly are very desirable under any weather condition. Likewise, radio equipped airways are useful to equipped aircraft under all conditions of weather and are highly useful to aircraft flying VFR when weather conditions are marginal.

Radio coverage on the Federal Airways to a reasonable minimum altitude, preferably to within 500 ft. above terrain, should be pro-

within economic limits. The VOR ies now commissioned or planned for areas of the U.S. in which relatively errain predominates should provide ap- nately that coverage. In considering the mic factors for those areas, it should be nized that short gaps in signal coverage be tolerated under VFR conditions. In nountainous sections of the U.S., nota- that area west of 105° west longitude, etention of great many of the existing F ranges may be required to provide the ed coverage below minimum instrument des, at least for some years.

retention of L/MF radio ranges in er numbers than originally anticipated does not minimize the importance of ex- ng the change from L/MF to VOR as asic short-range navigation system for flight.

e continuance for an indefinite period of hort-range navigation systems for traffic ol purposes presents many problems if nt and anticipated future traffic is to be ed safely and without loss of efficiency. efore, it is anticipated that when a ma- of IFR users become VOR equipped se of VOR will become a mandatory re- ment for filing an IFR flight plan.

les Airport Service

eldon "Torch" Lewis, Chief Pilot for A member *Thatcher Glass Mfg. Co., Inc.*, a, New York, has advised National quarters about a most "welcome and warming experience" during a recent ess flight to Mexico with company offi- He stated that Airport Manager George lorf of the Nogales International Air- in Arizona went all-out in aiding him ar American and Mexican customs. Said s, "Usually these things are so incon- ncing—but to land, refuel, eat lunch, customs and be back in the air with people in 45 minutes flat is something record."

these days, when efficient and courteous ce is a rare thing at many airports nd the nation, it is gratifying to com- airport managers for performing an anding job. Mr. Oberdorf deserves a y "thanks" from all CAOA members and d receive the financial support of mem- ilots flying in the Nogales area.

ion Industry Scored on its ade Toward Flight Safety

nsultant Ben. O. Howard, in one of the comprehensive criticisms of present aviation safety thinking, has charged the industry must change its "whole ade toward flight safety" if worthwhile ctions in crash rates are to be expected ard, one of the industry's best-known test engineering consultants, left no segment e industry unscathed. Pointed out were ollowing specific safety shortcomings:

was contended by Howard that the g yardstick was being used to measure ion safety. "An objective analysis of the d will disclose the fallacy of equating y on a loss per mile or loss per hour " . . . "The risks associated with flying ome 95% the result of the flight having made and 5% the result of the flight and distance involved."

ward also stressed that safety efforts be increased. "The greater sensitivity ir more modern airplanes to crash ex- e emphasizes this need. The records show that if we replaced the present DC-3 and DC-4 domestic schedules with the more modern two and four-engine airplanes, the average crash rate per mile for the whole domestic service would nearly be doubled." According to Howard, these same records show that the DC-3 cannot be certificated under today's requirements, although it is considered five times safer than the DC-6 and *Constellation* and nearly three times safer than the DC-4 and Convair-Liner.

There is a strange willingness to tolerate crashes, Howard further stated. After an exhaustive study of a DC-4 crash, the Civil Aeronautics Board established the cause as an engaged gust lock on take-off. "As a result," he charged, "they decided on six items of required corrective action, none of which was even related to the gust lock," and "five years later it was decided to require this protection but only in new design."

Howard further claimed misuse of cockpit controls. "The most damning example of what has been tolerated has resulted in the deaths of some 8,000 persons, representing about one-third of all crashes from all causes, in spite of the fact that they can be positively prevented by simple and obvious mechanical means." He stated that usually, but improperly, crashes are charged to pilot error. Such crashes are of a type that "can happen to one model airplane and cannot happen to another of the same general category" and are the result of design error. Since the pilots are the same in both cases, only the airplane can be responsible.

Cockpit design deficiencies are responsible for 15 times as many crashes as result from structural failure, Howard declared, yet there is very little comparison in the "engineering dignity" we give the two subjects . . . "We seem willing to shrug off the responsibility of providing safe controls by leaving it up to the pilot to read his check list, which is like depending on a sign to keep people from falling down an open elevator shaft . . . it just doesn't work and the records prove it" . . . "any airplane that requires the use of a check list for safety is in fact unsafe."

Howard pointed out that it appears that the more assistance the pilot has in flying the airplane, the greater will be the probability of a crash. He explained that past records will support arguments that crash expectancy resulting from flight crew deficiency is considerably increased when, with respect to safety, operation of the airplane requires the assistance of a flight engineer or a third crew member.

Howard expressed confusion about the aircraft designer's treatment of the aircraft fire problem when he said, "a great deal more attention is given to detection and control than is given to origin and source." Reductions in fire risk can be reduced only by such simple expedients as the use of fire-resistant hydraulic fluid and minimum necessary pressures in tank-to-engine fuel lines, he added.

Howard also charged that "we should reexamine our concepts, which now allow us to consider acceptable an airplane which we feel is so likely to end up on a crash that our conscience forces us into having the passengers turn their backs on what is expected to happen."

"Our regulating agencies must change their psychology," he said. "They make a great deal more fuss over the effects of humidity on a take-off than they do over the effects of locked controls . . . over legal aspects than over the lethal aspects of a flight."

Denouncing the steps taken to make crashes survivable as entirely disproportionate to those taken to prevent crashes, Howard cited the recent decision of one airline operator to voluntarily reduce the earning capacity of each airplane over a quarter of a million dollars a year by reducing the number of passengers carried and who would have to be evacuated in event of fire following a crash. For a small percentage of the cost of the reduction in consequences by preventing the occurrence of a serious fire and for still less the probability of the crash could be reduced by some 75%, he concluded.

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McDowell & Co., Cleveland, Ohio
Pierce Glass Company, Port Allegany, Penna.
Sangamo Electric Co., Springfield, Illinois
Shea Chemical Corp., Baltimore, Maryland
The Texas Company, New York, New York

BUSINESS DC-3, *owned and operated by Armco Steel Corporation, was photographed at LaGuardia Field, N. Y. Its pilot, Walt Pague, is Armco's CAOA representative*

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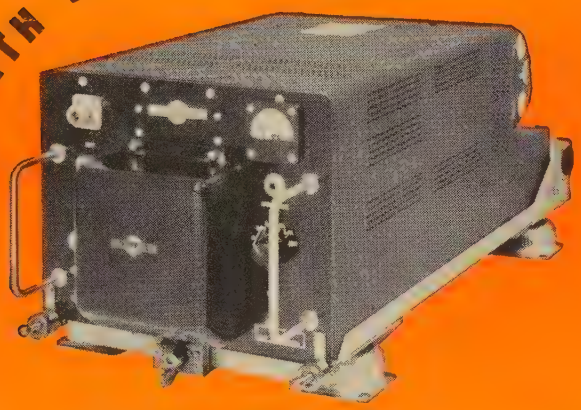
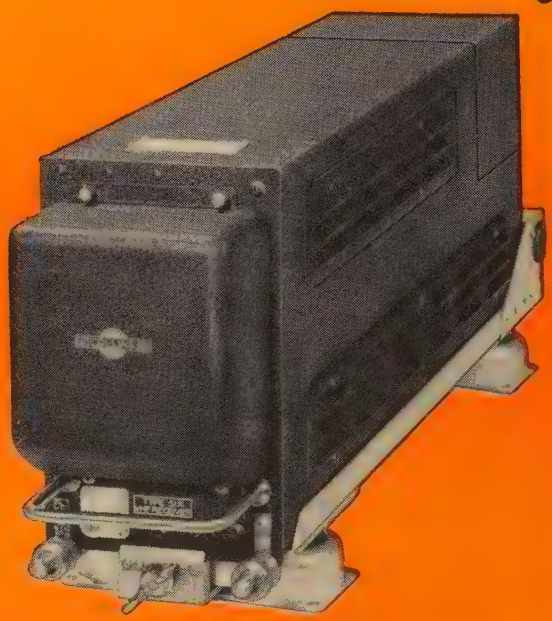


COLLINS 17M-1 VHF
Airborne Transmitter



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Airborne Communications Receiver

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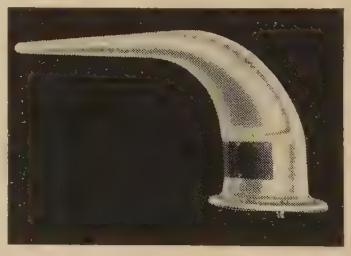
With the 17M-1 360 Channel VHF transmitter, Collins standard fingertip control puts the 50 watt signal on any authorized VHF channel without delay or manual tuning. Excellent frequency stability, high output and high-level modulation put the signal into the busiest terminals.

The 51X 360 channel VHF receiver is the companion to the 17M-1. 50 kc channel spacing provides complete VHF coverage for all present and future needs. Same famous Collins fingertip remote control circuitry as used for Collins 51R receiver and adopted as standard by the airborne equipment industry. The 51X has the sensitivity, selectivity and spurious response rejection characteristics required for flight and airport traffic control.



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/OR Program Progresses Slowly

Problem is in the coordination of control between VOR, LF systems

One of the problems confronting both lots and Federal Airways Control per- nnel is the coordination of control and paration between flights employing the w Victor airways system (VOR's) and e old and officially regarded "obsolete" airways system.

Pilots on average long-distance flights siring to employ and enjoy the ad- ntages of the VHF navigational system which they equipped themselves in e face of the threatened early extinc- on of the older system, are occasionally rplexed by the necessity to revert to e old system for portions of their flight conducted under Instrument Flight les.

When this occurs on portions of their utes where, although VHF naviga- nal facilities exist, a surveyed and ap- oved civil controlled airway has not en designated, the reason for being re- ested to change to the LF airway sys- m is quite understandable. However, may be more difficult for them to un- rstand why it should occur in portions their route where coincident VHF d LF airways exist.

One reason for this becomes clear en we realize that the bulk of IFR ffic is scheduled air carrier and that, th outstanding exceptions, many of ese companies and the military have parently not been able to equip them- lves with sufficient VOR and DME uipment to make programmed use of e VHF airways. This is one of the ajor reasons why the LF system is still e backbone of the domestic airways, us a diminishing number of VAR Visual-Aural) type ranges.

Another reason is the fact that where OR and LF airways are not entirely mpatible, by reason of required re- rting fixes over which the progress of craft along the airways are measured, d/or occasional track deviations which e not sufficiently separated to permit nultaneous use, it is necessary for ATC ntrol centers to base their computa- ns on the LF airway which still carries e bulk of the traffic.

Thus, if two aircraft are enroute along airway which is both VHF and LF or along which the separation between both system airways is not equal to the minimum separation standards required, the aircraft flying the LF system airway can easily be calculated and given clearance to proceed based on similar progress reports of the other traffic using that system. On the other hand, the aircraft flying the VHF airway, reporting at different points along the same airway or at points at tangents to the LF airway, poses a considerably more complicated and difficult problem of separation.

Hence, wherever conflict between operations of the two systems precludes effective use of the available airspace, the ATC personnel may request VOR flights to change to the low-frequency system for navigation and reports for portions of their routes. This presumes, of course, that such a flight, filing IFR via a Victor airway, possesses the low-frequency navigational equipment suitable to the route or portion of the route involved, which most aircraft would.

If, for any reason, the pilot of such a flight was unable to comply with that request because of lack or malfunctioning of low-frequency equipment or other conditions, he would still be cleared via the VHF route, albeit with such unavoidable delay as might be necessary to insure safe and adequate separation. Similarly, subsequent traffic using the LF airway system would be additionally delayed for the same reason and the entire flow of traffic along the airway somewhat retarded. Nevertheless, the pilot would not be penalized by loss of sequence or other disadvantageous handling because of his inability to operate on the most heavily used system.

Wherever possible to avoid delay without resorting to requesting a pilot to change his route system, ATC would not necessarily request the changeover for their convenience.

It is logical to conclude that as the VHF system advances to completion and greater usage, the shoe might soon be on the other foot. Pilots filing flight plans via the low-frequency airways may be requested to convert portions of their flights to the VHF system to avoid delay.

At the present time, the expansion of the Victor airways system is progressing slowly but steadily. Most of the VOR facilities are in, although too many are subject to periods of relocation and modification to bring their performance up to standard. Position fixing, other than "over" reports, is predominantly dependent on cross-fixing, intersection with or cross-bearings on the existent low-frequency facilities. DME, both ground and airborne, is still a far cry from a country-wide facility.

In many instances, both routine installations and modification or relocation is retarded by budgetary considerations. Due to the very situation mentioned heretofore, the necessity to maintain LF facilities has placed a strain on CAA funds which is naturally reflected in curtailment of the rate of progress of the VHF program.

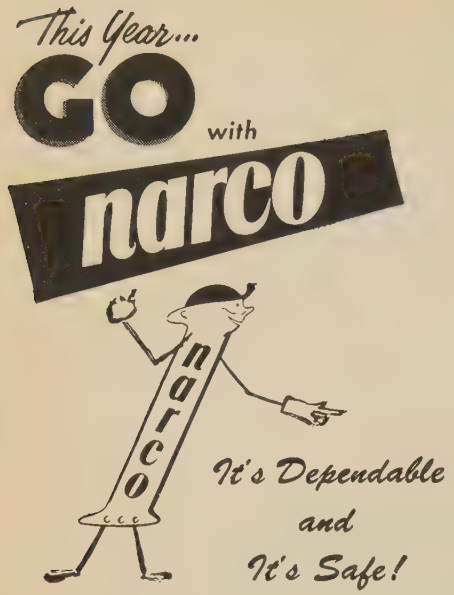
Nevertheless, some of the more prominent gaps in the VHF system are being steadily filled. The policy has been to try to fill in obvious gaps in the country-wide coverage by all air navigation type facilities, such as in areas of the West, while still not disregarding the demands of the more heavily used airways in the East.

In the nine months since the Victor system was formally launched, the system has stretched a wide belt across the nation diagonally from Maine to Texas, between the Appalachians and the Rockies. The coastwise systems have notable gaps such as between the Carolinas and New York in the East, and between portions of Southern California, Northern California and Seattle in the West. In most instances the facilities are in, but for numerous and varied technical reasons, the airways have not been designated, although new ones are announced almost daily.

The Gulf Coast coverage between Brownsville on the west and Florida on the east, is virtually complete, lacking only minor portions. The Denver to Las Vegas link is almost completed and will provide a good alternate routing between Chicago and Los Angeles. Many of the north-south short and direct routes between cities like Little Rock-Tulsa; El Paso-Amarillo, Amarillo-Denver, and San Antonio-Houston either are filled in, or in the process. The northwest routes from Chicago and Minneapolis to Montana and the State of Washington are still to be opened.

So, in general, although the bulk of airways traffic, at least IFR traffic, for

(Continued on page 34)



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(Continued from page 33)

some years may rely on the LF system, the day is coming when the bulk of the airway users will be both equipped and qualified to operate purely VHF. And at that time, it is hoped that the Victor Airway system will be complete and reliable.

New Weather Eyes for Pilots Foreseen

Development of a new type of airborne weather-detection radar unit by the Radio Corporation of America in cooperation with United Airlines, has just been announced. This is the first program RCA has undertaken with the goal of providing pilots with a practical airborne radar designed exclusively for weather-mapping use.

Other large airline companies have participated in civil airborne radar developments, notably TWA and AA; but beyond the anti-collision type application, there has been no widespread indication that present capabilities justifies the space and weight penalties for everyday fleet usage. UAL, who were in the forefront some years ago with their technical and research programs, may surge into leadership again if they can provide the pilot with the "weather-eye" so necessary to "see" his way around areas of heavy precipitation and turbulence. Along with navigational error and undetected design deficiencies, extreme turbulence has become one of the major factors in accidents of recent years.

This RCA radar unit will operate at new frequencies to "map" weather obstacles on a wide front. It is expected to provide patterns on a radarscope that will give the pilot information on the *depth* as well as the breadth and height of storm fronts. In regular usage, this can mean better trip dependability and passenger comfort. More urgently, it can mean greater safety. Aside from early warning, at night or on instruments, of probable severe turbulence, with attendant decisions as to speed and other flight adjustments, it can also forecast the practicality of route and track deviation to detour the worst areas and/or the possibilities of continued flight through a comparatively small area.

It is even possible that flight cancellation or return without having first experienced the dangerous sampling of extreme turbulence can forestall this inherently dangerous practice.

RCA expects to deliver experimental equipment early this summer so that tests can be conducted during the period of greatest storm activity. Mr. W. W. Watts, vice president in charge of RCA Engineering Products Department, said that RCA will provide engineering services required for installation and flight evaluation tests for the experimental unit.

Revised Landing Minimums at LG

Re-survey of approach facilities, su rounding terrain changes and consider tions, and numerous other factors incl ding analysis of approach-performanc records, continually results in the alte ing of instrument approach limits. Se eral offices of CAA participate in the d termination of what, in the publi interest, constitutes safe minimums fo landing approach. As a result from tim to time limits are raised or lowered Good policy dictates that pilots, not en joying the advantages of a large airlin staff to keep up with the changes, shoul be alert to such changes as they are an nounced and be guided accordingly i operation and flight planning.

Inasmuch as the average non-airlin pilot must abide by the minimums pr scribed in the Flight Information Manu al, unless a special waiver of the pub lished minimums has been obtained, it a general rule that airline minimums ar lower than the general civil minimum and are set forth in the air-carriers op erating certificate and the pilot's com pany operations manual.

At the present time a peculiar situa tion exists in the New York area where at time of writing, the air-carrier min mums in certain categories are *highe* as set forth for LaGuardia Field, tha the general civil minimums. A recen change raises the Straight-In LF rang and ADF approach minimums from th northeast to 600 feet and 1 mile visibi ity for twin-engine air-carrier aircraf and 600 feet and 1½ miles for fou engine. Civil non-airline minimums re main 500 feet and 1 mile Straight-I landing runway No. 22. Similarly, fo air-carriers, the Straight-In LFR an ADF approach from the southwest land ing runway No. 4 for all aircraft wa raised to 600 feet and 1 mile, civil non airline remaining 500 feet and 1 mile.

The ILS Straight-In approach min mums landing runway No. 4 for ai lines was unchanged, remaining 400 fe and ¾ mile visibility as compared t non-airline 400 feet and 1 mile; bu circling or Regular limits (to land a other runway after breaking belo clouds) was raised to 600 feet and mile when the Glide Path is inoperativ previously 500 feet and 1 mile.

The significance of this to non-airlin pilots is that it is most unlikely that civ non-airline minimums will remain bett than corresponding airline minimum for the obvious reason that the airlin generally have the facilities, equipmen training and check programs to justi the lower minimums. This has not an will not ever preclude competent an appropriately equipped non-airlin pilots from obtaining waiver of min mums as need and demonstrated.

ıcidentally, the initial approach alti-
es for both LFR and ADF approaches
eing made to conform with the MEA
inimum Enroute Altitudes) on each
rse of the range as well as approving
F tracks direct to the approach radio-
con from the secondary radio fixes.
dditionally, the Back Course ap-
ach of the ILS has been approved
should be published currently.
ıimums of 400 and 1 mile Straight-In
way No. 22 and proportionately
ıer circling and alternate airport minimums may be anticipated.

Although the civil non-airline pilot, usually flying aircraft of DC-3 and Twin-Beech type or smaller, does not generally enjoy the advantages of the "Sliding Scale" permitting airline flights a reduction in visibility with proportionate increase in reported ceiling to 1500 feet and ½ mile visibility, the application of the regulation authorizing aircraft with stall speeds of 75 mph or less, a reduction of ½ mile and/or 100 feet is somewhat compensating.

Nav-Aid Changes

BEDFORD (BOSTON), Mass.—*Plans are afoot to amend the mismatch of the ILS Glide Path frequency with the Localizer. Users employing tied-in Localizer and Glide Path receivers should note that GP frequency is 332.6 mc instead of 335.0 mc usually associated with Localizer on 108.3 and 110.3. Nearby Logan ILS GP is on 335.0 mc.*

BINGHAMTON, N.Y.—*Glide Path on 335.0 should be commissioned by this date, completing ILS installation. DME on test basis with Mohawk Airlines co-operating in service tests all along their routes.*

BUFFALO AREA—*Check charts and note that dog-leg on northern alternate route NY-DET-CHI and the Northwest via Red 23, Red 11 and Green 2 has been eliminated by swinging Can. Clear Creek east course to bear on Dunkirk (259°) and provide direct RED 11 from Dansville through Dunkirk.*

CHICAGO, Ill.—*Switch of Ground Control from 121.9 to 121.7 was postponed from original date. Either O'Hare or Midway airports must yield to eliminate confliction.*

COLUMBIA, S.C.—*ILS Localizer commissioned, Glide Path to follow. Freq. 110.3 mc, approach bearing 045°, back course not authorized.*

ISLIP, N.Y. (MacArthur)—*Tower 121.3 decommissioned; 121.7 commissioned.*

ROCHESTER, N.Y.—*ILS completed by commissioning of Glide Path on associated channel of 335.0 mc. Altitude over outer marker is 2100 ft. MSL, and over middle marker 793 ft. MSL.*

General Note:—*CAUTION.* When using ILS courses at intersection with other ILS courses, or other facilities for position fixing, simultaneous use of certain VHF communications channels can cause erratic identifications. Example: Use of 124.1 affects Localizer reception on 110.3 mc. Cure—request changeover to another communications channel.

Comment: Numerous comments have been received on Nav-Aids ranging from enthusiastic approval to complete indifference. It must be pointed out again that there is no substitute for use of the excellent and complete government and commercial publications and manuals in careful flight planning. It is a fact, however, that many changes go unnoticed, either due to the volume of information or the frequency with which they occur, until they vitally affect the flight progress. Also, although nobody should be without the above publications for various reasons, many either do not have ready reference to them or neglect them until inconvenienced by a change or circumstance long published. Despite elaborate airline airway manuals, the larger companies employ people specifically to call these matters to the attention of their pilots.

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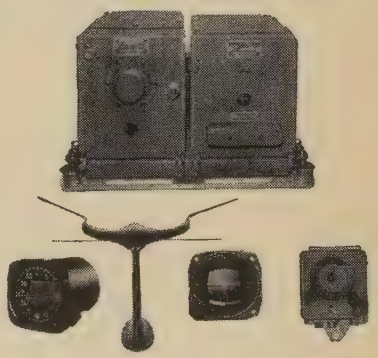

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Skyways Round Table

(Continued from page 23)

I think experience has shown pretty well that if you avoid these radar echoes by a reasonable distance of 5 or 10 miles, you will be able to avoid practically all the turbulence that is associated with these thunderstorms."

Sam Saint: *"Would you say that the worst turbulence is associated with the area in which the rainfall gradient is steepest, or to put that in simple language, the area where the pilot flies from no rain into a very heavy rain in the space of a few seconds? Is that normally where you would expect to find the worst turbulence?"*

A. F. Merewether: "Yes, that's my understanding from the work that was done by Frank White (now with ATA) when he was with American Airlines. He found that the greatest turbulence was associated *not* with the greatest amount of rain in any area but the gradient that was associated with the rainfall, changing from no rain to a very large amount in a very short distance, or vice versa."

Sam Saint: *"Would you say that these conclusions are subject to exception? For example, might there not be severe turbulence that has no precipitation associated with it at all?"*

A. F. Merewether: "Of course. You have the case of clear-air turbulence which is being experienced more frequently now with the operation of jets at the higher altitudes. But I don't think that radar is going to be a solution to that problem in any way, at least as far as I can see at the present time."

Sam Saint: *"Bill Carnes, do you have a comment that directly follows on this?"*

Wm. T. Carnes, Jr.: "I was just noting the paper that was presented by Mr. Tolefson of NACA at the Radar Weather Conference in Montreal. The NACA was the agency in the government that did all the basic work you're referring to. The curves shown in this paper indicate there is little difference between the gust velocities likely to be encountered in heavy rain and light rain, but that the conditions where the greatest gust velocity is encountered occur where close spacing exists between conditions of heavy rain and light rain."

Cole H. Morrow: "How does that appear on the scope? If I'm looking at a radarscope, what do I see that tells me that gradient is there? Do I see a black spot, a light spot, or a contrasting spot?"

Sam Saint: *"The storm appears as a bright echo, Cole, but there is no direct indication of rainfall gradient in a simple radar picture —except, perhaps, by noting the edges of the echo. The echo from a well-developed thunderstorm will have a sharply defined edge.*

"Let me hasten to say that Frank White worked out a bit of trick circuitry that can be added to a radar that will show a pilot a definite contour picture of the storm."

Cole H. Morrow: "What I wanted to bring out, Sam, is whether or not there's a very definite and positive indication on an airborne scope of where this point of high gradient precipitation occurs? Can it be easily and well defined?"

Joseph J. George: "I'm not convinced that that's the case under all circumstances, but in most cases it's so."

Wm. S. Parnell: "According to the same paper that Bill Carnes spoke of, the NACA also found that external to the cloud or this area precipitation where the maximum gradient is, the gusts that occur outside the cloud are equal to 70% of the turbulence in the cloud. It looks as though it's going to be necessary for such circuitry, so that as you approach a cloud or if you're trying to skirt an area of precipitation, you'll go around the side of the cloud that has the least steep gradient on it. You don't want to head around the steepest gradient."

Sam Saint: *"That brings us back to Col. Merewether's comment that if you dodge the echo of the storm by a margin of several miles, you've avoided this more complicated question of contour circuitry and gradient within the storm, etc.*

"Gentlemen, I'd like to bring the discussion back into the cockpit for a few minutes, and ask Capt. J. D. Smith how he views the necessity for a device that will show thunderstorms to the pilot."

Capt. J. D. Smith, *(Capital Airlines; Regional Safety Chairman, ALPA):* "From a pilot's standpoint, I think we'd be very interested in it. However, even after we have this thunderstorm information, we're faced with the problem of what to do about it or how to avoid the turbulent area. We have two problems from the pilot's standpoint: we have the terminal problem and the en route problem. Referring to the en route problem, a knowledge of thunderstorms, particularly their activity, would be very beneficial on high-altitude flights."

Avoiding Icing Conditions

Sam Saint: *"J.D., suppose this device could show you areas of super-cooled water droplets in the air which might produce a dangerous icing condition? Is icing less of a problem today with our modern airplanes and their heated wings than it has been in the past?"*

Capt. J. D. Smith: "Well, I think we have better ways of combating the effect of ice than we used to have. It would be very beneficial if we had the knowledge of where the ice was, particularly the levels of it. Still, the best way to handle ice is to avoid it. Just the other day I had a case where, if I'd been able to know the intensity of ice, it would have saved me a lot of trouble. It took me 15 minutes to climb 2,000 feet with emergency power. It was a very isolated condition and probably something that doesn't exist very often, but had I known that this ice area was there, I wouldn't have gone near it."

Sam Saint: *"That's my feeling, too. The severe type of icing that is apt to get a transport plane into trouble is a fairly rare occasion, but it can be a very real proble American Airlines, in operating a DC-4 w radar between Seattle and Anchorage, Alas did discover that with the radar pilots co very easily stay out of the severe icing tha quite common up in that area."*

Special Problems in Terminal Areas

Capt. J. D. Smith: "To get back to t thought of interpreting the information garding thunderstorm ahead, we would limited as to what course of action to foll even after we knew the storm was there. W the present systems we have now, traffic p mitting, we can most times change our a tude to handle the situation, but whether would always be able to circle the thing the distance required, or whether we cou follow that course, I'm not so sure."

Sam Saint: *"That's a good point, particul ly in the terminal areas where airways n mally lie as close together as we can safe place them. The opportunity to deviate arou the storms is very limited. I wonder if a one would agree that in these terminal are we are gradually making use of ground s veillance radar for traffic control, and th during those periods when storms are pre lent in the terminal area that the traffic co troller should take the initiative in routi traffic around the worst of the storm are Does that seem like a logical answer to t question?"*

Joseph J. George: "I thoroughly agree th for the most part, airborne radar will pro ably end up being of most use in avoidan of turbulence in thunderstorms in areas o side of the very heavy traffic. I think it logical to assume that the ground surveillan radar will be the key equipment for the hi density air routes."

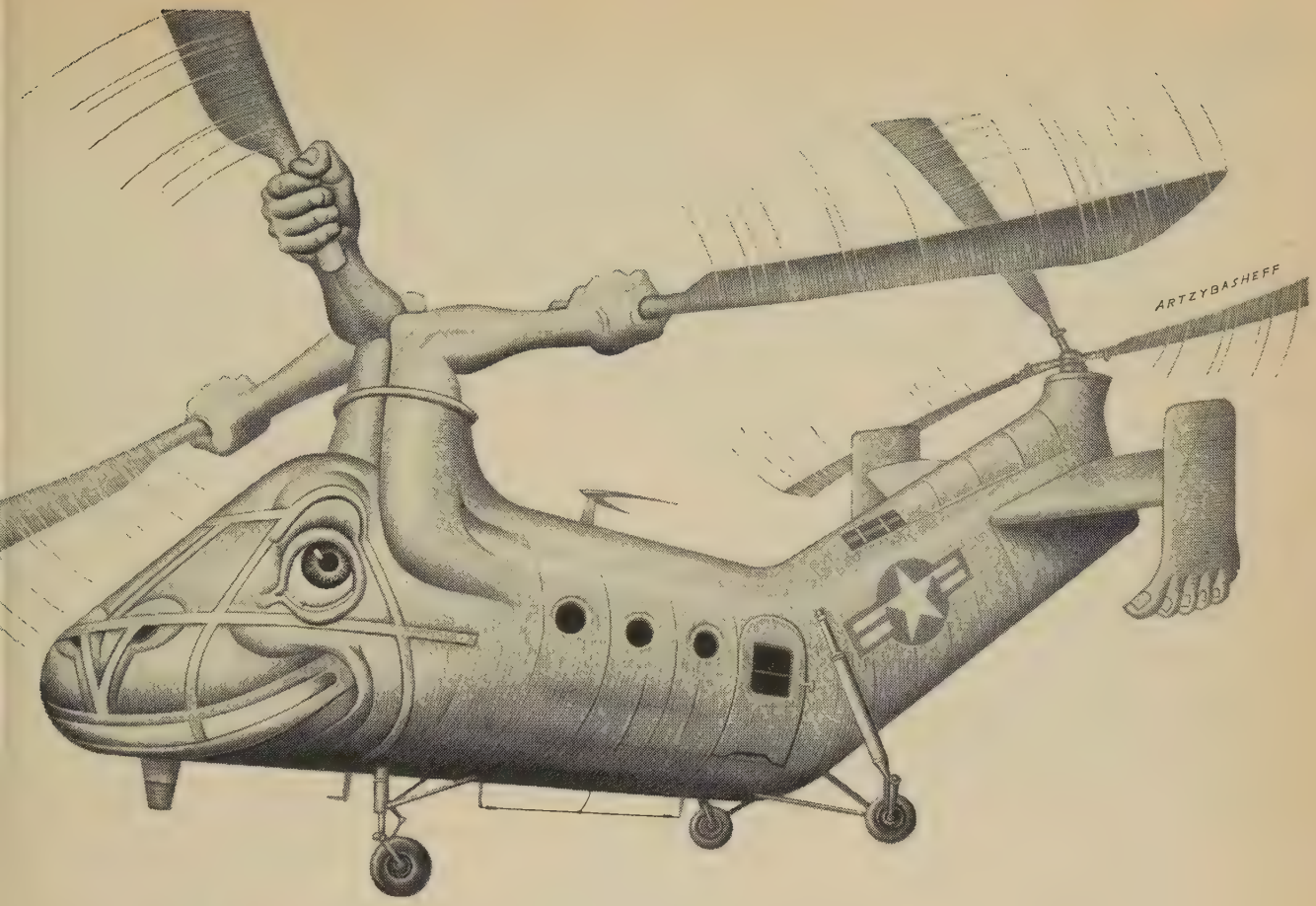
Capt. J. D. Smith: "Are you assuming th when we have airborne radar, we also w have the transponders in order to mainta positive identification between the grou controller and the aircraft when we start t circling of turbulent areas in the terminal If we start airplanes circling around heav turbulent air or areas of severe precipitati the possibility of misidentifying the aircr or losing it becomes more and more witho the airborne identifier."

Sam Saint: *"You are right, J. D. You ca talk about ground radars without askin 'When do we get the airborne beacons to ma the operation more positive?' I understa much of this question was covered in t Round Table on the subject, 'Ground Rad Traffic Control,' and printed in the Ap issue of* Skyways.

"I'd like to ask Mr. Stan Willey of BO what he thinks of the use of airborne radar avoiding weather. Mr. Willey has been as ciated with the operation of the British Com on some of its world-wide routes. Stan, wh do you think of the potential value of an a borne radar in operating a jet transport?"

E. S. Willey *(Operations Branch, Brit Overseas Airways):* "When you speak of a borne radar, Sam, I have in mind not o the equipment we've been talking about

(Continued on page 38)



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Skyways Round Table

(Continued from page 36)

the moment but also distance measuring equipment which, I think, comes within the orbit of this discussion.

"We are making great use of distance measuring equipment, and have installed DME on 200 megacycles at our main staging posts. It is of particular value in areas into which we are operating where there are relatively few and not entirely efficient radio navigational aides. For example, a sector which approaches the main staging post over the sea. DME gives you instantaneous distance off the main staging post, and you can judge just when to start your descent. In that respect, we are finding DME of very considerable value. Other by-products, of course, of the DME are that for certain approach-to-land procedures, it is very valuable. I think everyone can appreciate that in a range or beacon let-down procedure, it's of great value to know your distance from the range or beacon.

"I'd like to revert for a moment to Gen. George's point about the use of ground surveillance radar for giving information to aircraft on avoiding thunderstorms. The technicians can put me right if I'm wrong on this particular point, but as I see it, ground surveillance radar is being designed more or less specifically for traffic control purposes and I don't know whether this same equipment could give you the information on turbulence as you get from the airborne radar that we have been discussing hitherto."

Sam Saint: *"Who would care to pick up the ball here to discuss weather echoes as seen on various ground surveillance radars?"*

Wm. T. Carnes, Jr.: "I think we can all agree that, as Mr. Willey pointed out, the two ultimate purposes are exactly opposite. That is, we know that a lot of surveillance radars that are used today were not basically designed as surveillance radars and do run into trouble at times due to weather obscuring the return from the aircraft. We know that the best radar we can build for surveillance purposes isn't going to be good enough. At least, that seems to be the conclusion I get from some of the people working on them. Economically, you just can't put enough power and a big enough antenna on an airport to see the small aircraft you'd really like to see. So obscuring by weather is one of the things that we have to cope with and, in the long run, I suspect that we will work toward using the frequencies which were allocated for that purpose in the 1,000-cm band for surveillance radar. Thus, if we use these lower frequencies, we will obtain the freedom from weather we desire for good surveillance radar performance. However, it should be obvious that we won't see the weather with such a radar."

Sam Saint: *"Here again we have need for a certain amount of compromise, because we're asking the radar to do two different things for us. We want to track aircraft through precipitation areas, but we want to see the heavy precipitation areas so we can direct aircraft around the worst of the storm areas. Use of the airborne radar beacon that J.D. was reminding us about will, perhaps, let us have our cake and eat it, too."*

Experience Highlights Weather Problem

Capt. J. D. Smith: "Just for the record I'll give you one more reason why the radar information regarding thunderstorms is very helpful in high-altitude work. I know you are aware of how many aircraft have been banged up in the last few years in entering thunderstorm activity without any preceding warning. The aircraft just flew into these areas at 13, 14, and 15,000 feet and ran into some pretty severe hail storms. Now if we had the information in sufficient time that this activity was ahead, we could either slow down the airplane or circle the area and, in most cases, avoid the thing altogether."

Sam Saint: *"I can highlight your comment, J.D., from my own experience. In an American Airlines program, I flew with an airborne radar continuously for about a year and a half, and the first time I negotiated a bad*

(Continued on page 40)

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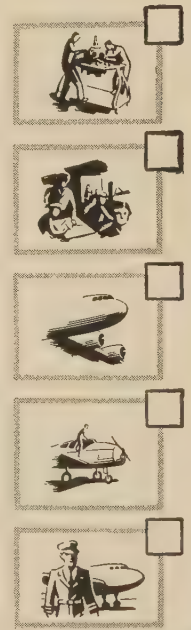

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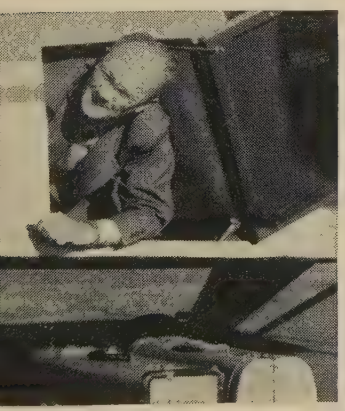

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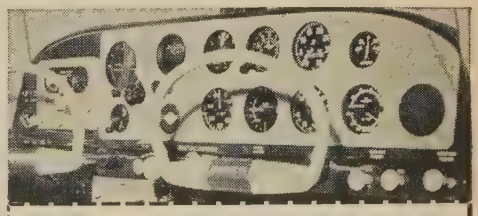

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Skyways Round Table

(Continued from page 38)

front without the radar on a regular schedule after leaving the experimental program, I felt that I was trying to operate without my right arm."

A. F. Merewether: "I think that it can be generally said that in the case of air-mass thunderstorms you would not have to divert very far from the thunderstorm core or the airways in order to get around the storm. In the case of frontal thunderstorms or squall lines, you might have to divert a greater distance. Nevertheless, I think that even in that case, the airborne radar would be able to picture to you the weak spots so that you could pick a weak spot within a reasonable distance and get through it.

I remember a flight we made from Chicago to Denver on this same program Sam mentioned. Dan Beard was flying the plane, and we took off from Chicago one evening around 7 o'clock. It was during the summer and there had been a lot of thunderstorms out west of Omaha, but they were dissipating. We thought we were going to have a flight with no weather problems at all. When we got into the vicinity of Omaha, the thunderstorms began to build up again and Dan Beard decided to stop at Omaha to make a check on the weather. By that time, however, the storms were building up all over the country and it looked as though the sky were on fire everywhere. I thought to myself, 'Gee, I'd hate to be an airline pilot starting out in this sort of situation.' But we were anxious to go because we had the airborne radar. We went out there with no difficulty at all and we were able to stay on the airway and maneuver around all of those storms. In fact, the trip was as smooth as it is sitting here at this table. When we arrived at Denver, We learned that an Eastbound flight through the same area at the same time we were passing through so smoothly Westbound was so torn up with turbulence that they had to land someplace along the line and inspect the ship before they could proceed any further.

"The pyschological effect, it seems to me, is important as far as the pilot is concerned. It's the fear of the unknown vs. knowing what you're getting into.

"The other point, of course, is the effect on the customers. I think we un-sell a lot of passengers by taking them out and giving them pretty much of a beating. The crews may not mind it too much, being used to it, but there are a lot of people with weak stomachs flying in the airplanes, and it seems to me we unintentionally maltreat a lot of our passengers. We could give them much better service if we had airborne radar."

Sam Saint: "*Col. Merewether has brought out a very important point in the psychological aspect of this thing. I once overheard a French pilot speak of the pilot's 'tranquility of spirit.' I think safety factor in the cockpit is almost directly related to this 'tranquility of spirit', and I can state from personal experience that an airborne radar on a night with a bad front across the course certainly contributes to the pilot's peace of mind in operating through that area.*"

Joseph J. George: "It is not only possible in the case of air-mass thunderstorms but it is also possible in some cases with line squalls and solid line thunderstorms to avoid them completely. There have been actual instances where aircraft have encountered pretty severe turbulence by penetrating line squalls when it wasn't necessary to do so and possibly wouldn't have happened if they had had the airborne radar."

Radar sees Mountains

Sam Saint: "*I'd like to turn our attention now to the question of terrain avoidance. We've heard from time to time that an airborne radar does give some collision warning against mountainous or high terrain. How important a problem is this in airline flying today?*"

Capt. R. D. Fordyce: "I suppose you might argue that with pressurized equipment it is somewhat less important than it used to be. But you still and always will have the condition of climbing up to cruising altitudes and letting down from them, so your problem still remains. For a long time to come there are going to be a great many areas in the world where we won't have much in the way of VHF equipment to give us complete position information."

Sam Saint: "*Reading between those last lines, Bob, it sounded as though you were saying that radar terrain information in the cockpit might be more important in certain areas of the world than it is, for example, between New York and Chicago.*"

Capt. R. D. Fordyce: "I'd say it would probably be more important in any mountainous area than it would be between New York and Chicago where you're not in mountainous territory on climb-out and let-down, and well above mountains while cruising. Speaking of our own operations primarily, where it would do us the most good is in the more or less remote areas where the facilities are never likely to be extremely good, for example, South America, Africa and areas where traffic densities aren't sufficient to justify ample VHF facilities. How important it would be in the United States would be determined more or less by the accident rate attributable to terrain collision."

Capt. J. D. Smith: "I'm not quite clear as to how this information would be transposed to the pilot. Would it be on the screen, some dials, or how?"

Sam Saint: "*I wonder if I could persuade Bill Carnes to attempt an answer to that question. This seems like the appropriate time to decide whether or not airborne radar will actually function as a collision warning device. We are speaking here specifically of collision with high terrain.*"

Wm. T. Carnes, Jr.: "Some manufacturers have suggested that they could put altimeter information in the radar and have a regular altimeter indication on it, but when you start pinning them down, it appears that it's not going to be simple to do. If we're going to install this radar for its primary purpose, we do not want to complicate it by adding secondary purposes or uses which it may not perform well enough to justify the additional complexity. The airlines now feel that no presentation other than the normal PPI should be provided. If you want an altimeter indication, install an altimeter in the airplane."

Sam Saint: "*Well, that's an angle of discussion I didn't anticipate. Perhaps we should agree that the airborne radar should not have any additional complication of this type added to it. The question we are interested in is this: 'Is there real value in the basic airborne radar presentation as a terrain warning device?*"

Capt. J. D. Smith: "We tried something along that terrain warning line some years ago. It wasn't as glamorous as radar, but it was a terrain warning indicator, a terrain altimeter. But the method used to transfer the information to the pilot did nothing but create mass pandemonium in the cockpit. We had a couple of red and green lights that were very inaccurate. You'd be flying over mountainous terrain, and every time this red light came on, you'd just about jump out of the cockpit. The altimeter said you were at the right altitude and you knew you had sufficient clearance, but the red light would come on anyway.

"I'd suggest, therefore, that if you decide to supply this kind of information to the pilot, it be done in a most accurate manner. There's nothing worse than sitting in a cockpit, seeing a red light that tells you that you are too low when everything else says you're all right, particularly on instrument approaches."

"Safety Circle" Technique

Capt. R. D. Fordyce: "Sam, wouldn't this be a good time for you to explain the 'safety circle system' you developed at American?"

Sam Saint: "*During our airborne radar evaluation program at American Airlines, we did develop a technique for using the basic radar picture as a terrain-warning device.*

"*Bob, I can answer your question best by stealing a few paragraphs and a sketch (page 44) from an article I wrote in December 1952 issue of the* Air Line Pilot.

" '*The radar tells its terrain story in two ways. The initial indication comes from the fact that a ridge or mountain, approaching above the flight altitude, casts a radar shadow. The radar cannot see the terrain beyond the mountain; therefore, this portion of the scope will be black. As the ridge approaches, this shadow will move down across the scope like a black window shade. This initial indication, however, is only a warning of potential trouble. It does not tell the pilot whether he is safe or not at any given moment.*

" '*Positive knowledge of terrain clearance comes from what has been termed the "safety*

(Continued on page 44)

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Skyways Round Table

(Continued from page 40)

circle" in the center of the scope. From the accompanying sketch and photo you will see that where a pencil-beam type of scan is used, a shadow area is created in the center of the scope. You will realize that the radius of this shadow area is proportional to the height of the aircraft above the terrain. Analysis will show that the shape of this shadow area will tell the pilot which way to turn for greater terrain clearance. For example, an elongated portion of the safety circle will point down the valley. This is positive knowledge of terrain clearance. In practice the pilot will become used to pushing this safety shadow area ahead of him as he flies. Anything that invades this safety circle will be of immediate concern. This "safety circle" technique loses its value below an altitude of approximately 1500 feet. This is true because the radius of the safety circle becomes too small to be of value.

"'An airborne radar has these advantages over other terrain warning devices. It gives advance warning—often from 20 to 30 miles in advance. It tells the pilot which way to turn. The indication is a trustworthy indication; there can be no question as to whether the pilot will act on the indication. The radar does its job at the end of the line; that is, it does not matter why *the airplane has gotten into a dangerous position. It simply says, heads up!'"*

A. F. Merewether: "What about this in connection with the progress of weather?"

Sam Saint: *"If you are in the proximity of mountain peaks and there are storms intermingled among these peaks, it becomes relatively difficult to tell which is which."*

Capt. R. D. Fordyce: "Generally, it did not seem too difficult to distinguish between terrain around mountain peaks and the storms close to them because the storms have a somewhat fuzzier appearance."

Sam Saint: *"I think, Bob, that some storms will look exactly like mountains. I think it's impossible to be sure from just looks alone. But if the aircraft is flying well above the tops of the peaks, running the tilt of the antenna up and down will isolate the storms from the mountains quite easily. But if you're flying down close to the tops of the mountains, you can be mistaken.*

"There was developed a method of getting around this. Frank White, who was associated with our project, sparkplugged the development of a gimmick which allows the pilot to switch the radar from circular to horizontal polarization. When the radar is switched to circular polarization, the echo from water droplets is very much reduced so that it immediately becomes apparent whether this cloud you are concerned with has rocks in it or not. This is a complication that can be added to the radar, but I'd say again it's a question of whether or not you want to pay the additional cost to get this additional service."

J. D. Smith: "How far in advance would the pilot get an indication that there was a possibility of hitting a mountain?"

Sam Saint: *"Well, J. D., we used to fly up the Hudson River and we would first see the shoulder of the Catskills moving in on us from about 20 or 30 miles away. Proof positive that this was high terrain moving toward us in a dangerous fashion was not apparent on the scope until we were within 5 or 6 miles of the actual point of collision."*

J. D. Smith: "That's the point I was trying to get at when you mentioned switching from horizontal to circular polarization. If the pilot were flying at his minimum altitude through mountainous terrain and he did have weather along with this indication, do you think he'd have enough time to make the switch to properly evaluate what the problem is?"

R. D. Fordyce: "I think the standard answer is that he doesn't want to get into either one. But to amplify Sam Saint's comments on t Catskills, we had a cargo plane that we op ated with this APS-10. With the hood up flew all over Switzerland and Greece, do through the valleys and between mounta peaks without any trouble whatsoever a without any other aids whatsoever."

Need for Brighter Displays

Sam Saint: *"There's one question th should come out in connection with airbor radar as a terrain warning device, and that whether or not the radarscopes, as we kn them today, are sufficiently arrestive to c the pilot's attention when he's not worri about the proximity of terrain?"*

Wm. T. Carnes, Jr.: "It's a question, Sa of whether the scopes are adequate for a operation today, as we know it in the airlin It's not just as applied to terrain avoidan but this is a question applicable to all uses radar."

Sam Saint: *"I just want to bring out t thought here that a bright tube display u improve the radar's characteristic as a terra warning device."*

E. S. Willey: "You may have to make the sufficiently arrestive to literally hit the pi in the eye! Cockpit drills and aircraft spec are making a cockpit job these days occu about 110% of a pilot's time. That's the b issue with the use of airborne radar, I think

J. D. Smith: "Do the manufacturers fe that they can put a scope in the present a craft that will provide all this informatio Will there be room for it?"

Owen K. Lindley *(Sales Mgr., General El tric):* "We are told that there is room."

Sam Saint: *"It's my own personal impr sion that the airborne radar gives the pi enough of a psychological sense of seei and enough information in simple predigest form so that there is no over-all increase workload in the normal use of an airbor radar."*

Capt. R. D. Fordyce: "I think that's ve true."

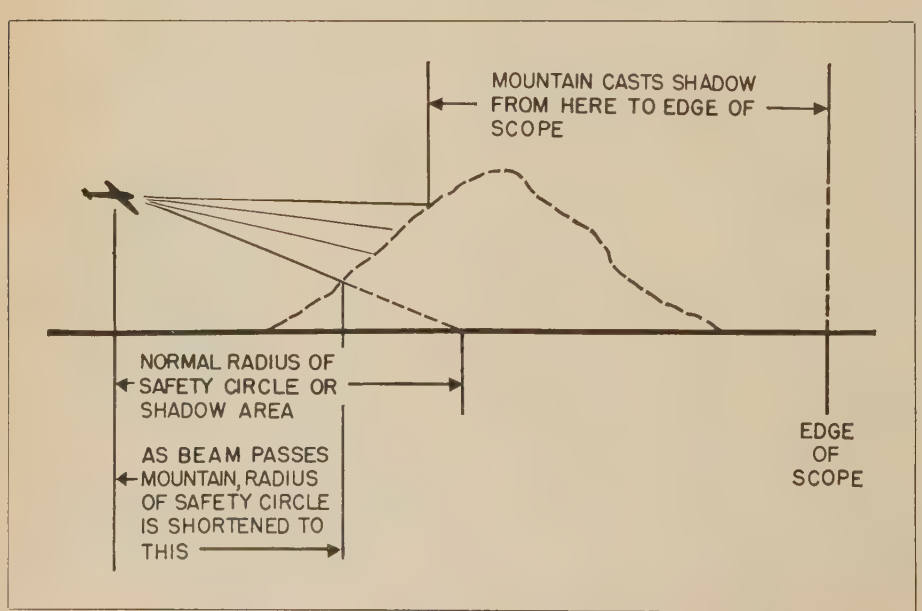
Sam Saint: *"Before leaving this aspect the problem. I might add that we conduct an experiment with five American Airlin pilots and concluded that the airborne rad with existing scopes, becomes the most arr tive thing in the cockpit when operating darkness. We found that a terrain warni moving in on the scope, as displayed in dark cockpit, left no question as to the pilo seeing this warning. The five pilots—who, the way, had not seen radar before—agre they would see the indication, and agre they would act on it.*

"Don't ask me how we persuaded five pil to go up and fly below the tops of the mo tains in the darkness, but we did."

Capt. R. D. Fordyce: "Do you feel that borne radar when used for terrain avoidan implies the use of a stabilized antenna?"

Wm. T. Carnes, Jr.: "As of right no there's a definite difference of opinion in industry, but we hope to resolve it and kn the answer soon. Present airline specs do c for partial stabilization—roll stabilization

(Continued on page 46)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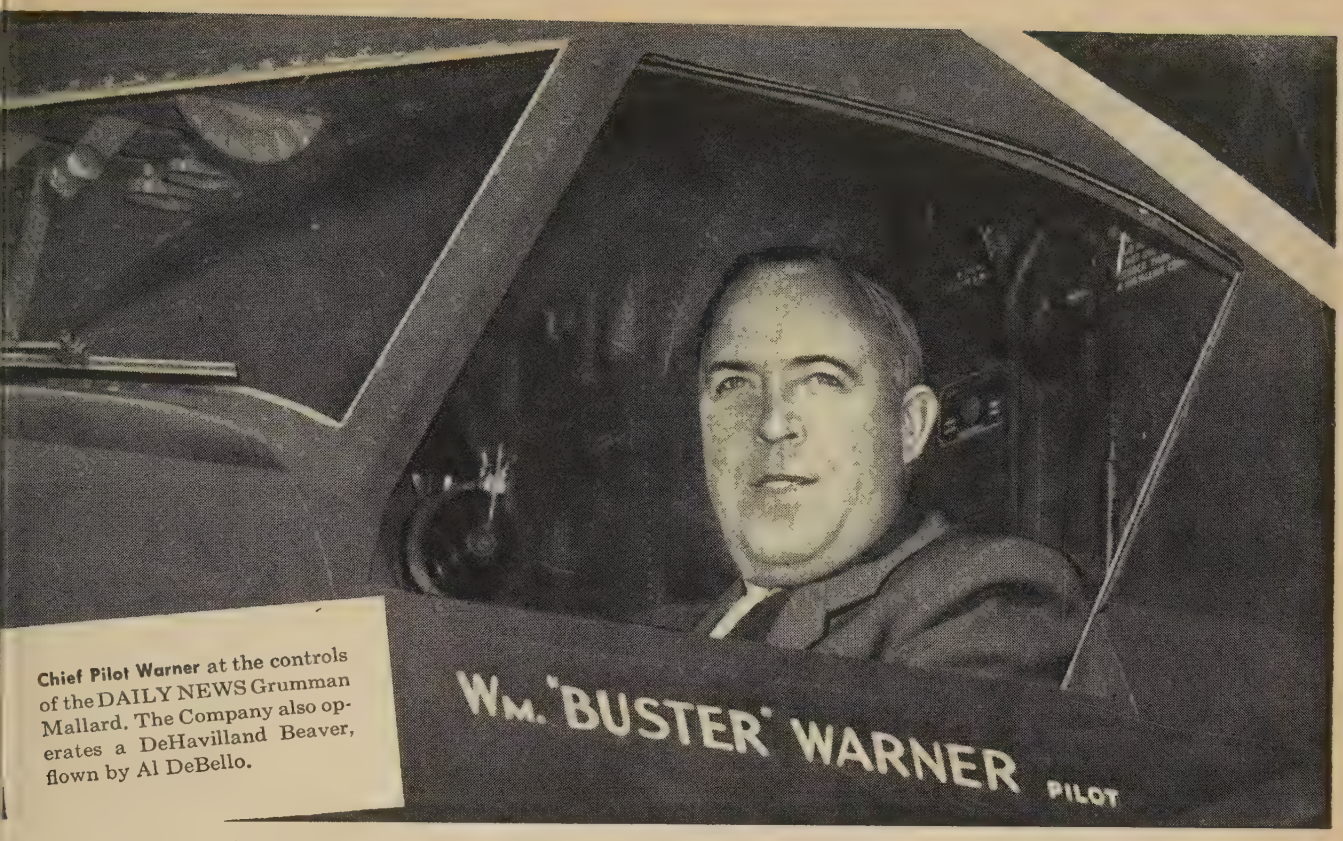

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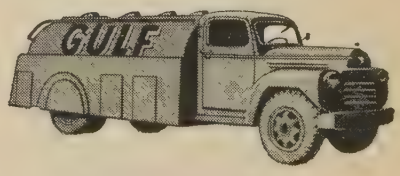

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SOUTH CAROLINA AERONAUTICS COMMISSION

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

Skyways Round Table

(Continued from page 44)

no pitch stabilization. However, as one airplane manufacturer has pointed out, with some future aircraft designs they expect that there may be much greater need for complete stabilization, including pitch stabilization, too, for any use of radar. On the other hand, certain airlines that have run tests have said that they don't need any stabilization for the type of operation in which they expect to utilize radar. So it's just a matter of our resolving the question on an industry basis, but it will take some time to do it."

Sam Saint: *"We might give the manufacturers a hint here by pointing out the desirability of building a simple radar designed in such a way that stabilization could be added later."*

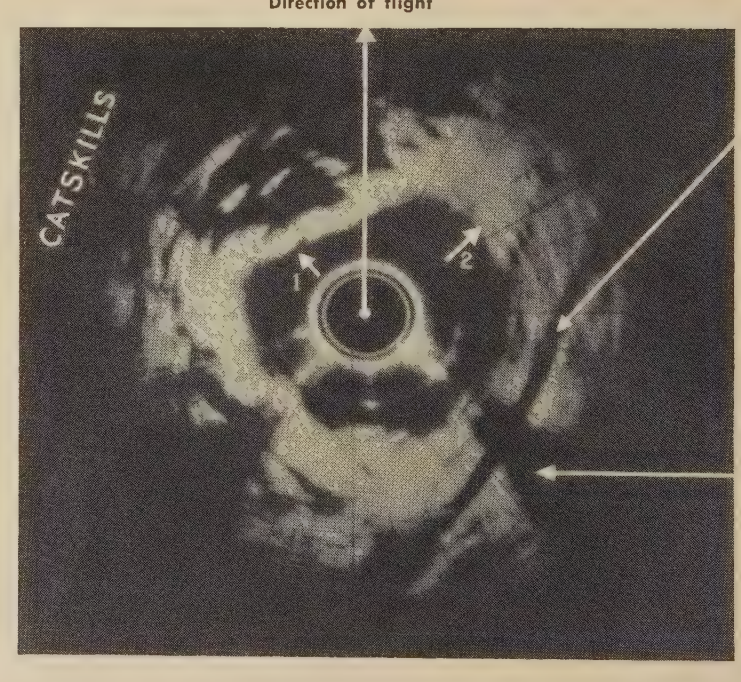
Wm. T. Carnes, Jr.: "Perhaps we should say it in a different way. Is there enough interest in stabilization on the part of a large enough segment of the industry today to justify the radar manufacturers designing a stabilized antenna which could be eliminated if we found out later we didn't need it? If we don't need a stabilized antenna, we could get a much cheaper one."

Sam Saint: *"I think we can leave this subject with the comment that this is one of the very difficult compromises. You may have a requirement, but that requirement costs weight and money, so we must balance one against the other and make our choice.*

"Let's go on now to the navigational aspects of airborne radar. I'd like to turn again to Capt. Fordyce, since his company has had some experience in operating an airborne radar over long routes."

Capt. R. D. Fordyce: "Maybe the best way for me to comment on that is to give you one example of our use of airborne radar for navigation. We went all the way from New York to Gander and then all the way across Europe from England to Syria navigating exclusively by radar over the entire trip, except over the long over-ocean hops. We never had any trouble spotting ourselves within a few miles of where we were, even in the flat featureless countries of Belgium and Holland, by picking up almost anything: towns, villages, hills, rivers, coastlines, and identifying on a standard aeronautical chart. We didn't run across any place where we could not navigate exclusively by radar. There were always a sufficient number of terrain irregularities to be readily identifiable from a map. Probably with somewhat better equipment, possibly a cosecant squared beam instead of a pencil beam, we could do even better. But again, as a sort of auxiliary aid, I don't know just what advantages it might have, other than in war time or in areas where you have extremely few aids. In parts of Africa, Asia or South America, it might be very useful."

Sam Saint: *"Bob, your experience navigating by airborne radar alone applies to a flight in which you knew your approximate position all the time. Suppose, for example, your navigator had become turned around and the aircraft was in an unknown position, and you*



RADARSCOPE *in cockpit shows aircraft on collision course with Catskill Mountains west of the Hudson River Valley north of Kingston, N. Y. Note distortion of "Safety Circle" at (1) in direction of nearest high ground, and (2) largest radius of "Safety Circle" looking up valley. Pilots says scope gives arrestive warning in night operation*

e trying to relate the airborne radar pic- to the map?"

apt. R. D. Fordyce: "The effectiveness ıld depend on what features visible on the ɒe could be identified by reference to a ɒ. If you had something like Cape Cod earing on your scope, you could easily ıte it to a map. Or if you have a peculiar ggle in a river, or a big town with another n next to it, identification would be quite ple. But unless you had some such fea- es, I don't see how it could be done well."

am Saint: *"The point I was trying to make, , is that on many of the route miles that fly, it would be extremely difficult to re- the airborne radar picture to the map ess you had a fairly good dead reckoning tion to start with or were fortunate ugh to have some characteristic landmark Cape Cod."*

apt. R. D. Fordyce: "You'll unquestionably areas where it would be impossible."

Wm. T. Carnes, Jr.: "One comment that I rd a few years ago, probably at about the ıe time Bob Fordyce was running his test, in regard to operation over Europe; this ividual pointed out that if they had radar, y'd put it on every airplane in their par- ılar airline fleet. However, this same in- idual pointed out that in the U.S., radar of little use for navigation. He said that r you left the East Coast, you could very l throw it out of the airplane; that in sing the states of Kansas, Texas, etc., re just weren't any landmarks that you ld pick up and properly identify with ar."

apt. J. D. Smith: "I recently saw a demon- tion of the pictorial computer which, as know, transposes on a map visible to the ɒt his track over the ground. In our opin- it isn't too beneficial to an airline opera- ıs for enroute problems. The pictorial ıputer merely tells us what we know al- dy. However, if the airborne radar would e us the same information as the pictorial ıputer does and your DME piped down to runway, then we'd have something. If a ɒt could look at a screen and watch this le pip coming right down the prescribed ck down the runway, getting altitude and ection over obstruction information, there'd nothing to it. If we're going to use air- ne radar for navigation utilization, let's ot for the works. We not only want en- te information on turbulence and icing, we ɒ want something that will get us down to end of the runway. That's where we're ing our airplane and that's our big prob- ."

am Saint: *"J. D., American Airlines had h hopes of developing a practical method using airborne radar for low approach. er hundreds of approaches conducted over eral months, we concluded that the defi- on of the radar picture was not good ugh to gunsight the runway. At the fre- ncies we were forced to use, the radar nts its picture with too broad a brush to the necessary detail. To sum up Capt. dyce's opinion on radar navigation and in a little of our own, we might conclude that airborne radar has not a great deal of value as a primary navigational aid. It's my own feeling that where a pilot is flying a familiar route, the radar landmarks along the route will also become familiar and will give the pilot a satisfying picture as he flies along those routes. But when he gets into congested areas, such as Chicago or New York, such characteristic landmarks are usually lacking. I wonder if that sums up the situation?"*

Cole H. Morrow: "The viewpoints that have been expressed here concern flying along specific airways. In the business-flying end of aviation, we have a need for flying off-airways, and our viewpoint does not entirely coincide with the requirements for flying along a specific route. We feel that there are many navigation aids that could be used very well for our kind of operation that get very little consideration from those who are flying along well-established routes where navigational aids are plentiful. I don't know whether airborne radar would be of value to us in flying off-airways, but I certainly would like to have that possibility kept on the record.

"How valuable would airborne radar be as a navigation aid used in conjunction with ground radar beacons?"

Sam Saint: *"Bill Carnes, will you discuss some of the problems involved in using ground beacons with airborne radar?"*

Wm. T. Carnes, Jr.: "In any system-planning where you become involved in compatibility between airborne equipment and ground equipment, you've got yourself into a complicated international long-range planning program, and it can take years and years to unravel.

"The good thing about airborne radar is that it is one of the few systems that we propose putting on an airplane where there is no compatibility problem involved. Anyone owning an airplane can put a radar on it and get some good out of it right away. He doesn't have to wait for the rest of the certificated aircraft in the world to become equipped with it, and he doesn't have to wait for compatible equipment to be installed on the ground all over the world to make this radar work.

"If we inject this problem of compatibility with ground beacons into the radar picture, it's going to slow up the airborne radar project. We all know of the slowness of the corresponding program of ground surveillance radar with airborne beacons, and how that has been confused by international problems of system standardization and frequency allocation. It's just about as confused now as it was many years ago. Therefore, we feel that since we're trying to get something that will meet a primary purpose of weather avoidance, we shouldn't confuse the issue and slow it down waiting for an almost impossible international standardization of a system of radar beacons.

"It is our belief that the frequency we pick for this airborne radar is not likely to be suitable for use with any existing ground beacon of any kind."

(Continued on page 48)

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Skyways Round Table

(Continued from page 47)

Sam Saint: *"We don't have a distinct representative of the small airplane operators here today, so on their behalf I'd like to remind everyone that the sort of equipment we're talking about cannot be readily carried in a small aircraft. Therefore, they could not participate in navigating on ground radar beacons.*

"Stan Willey, would an airborne radar in any way replace the requirements you've already stated for DME?"

E. S. Willey: "I don't think so, Sam. It could only be used as a supplementary aid, and I think it would have a very limited use as a navigational device."

Sam Saint: *"I'd like to raise the question now of air-to-air collision avoidance; the use of an airborne radar as a collision-warning device where other aircraft are concerned."*

Capt. J. D. Smith: "Before we get into that, I'd like another point of information. Is it anticipated that this equipment applying to air-to-air information also gives altitude information, or does it give the target with no altitude information?"

Sam Saint: *"I'd like to confine this discussion to air-to-air information without the altitude of the other aircraft for the simple reason that I don't think we're close to knowing how to make the other targets give us altitude information. We're working essentially with a picture that is in the flat two-dimensional plane showing azimuth and distance without altitude."*

Cole H. Morrow: "We discussed beam width a few minutes ago which I assumed to be horizontal beam width. Now that we're talking about air-to-air collision and also terrain collision considerations, I think they involve the vertical beam width. One of the things that is not clear to me is whether or not that is the same 5° we've been talking about. If it is, that narrows down the indication you're going to get of other aircraft. Theoretically an aircraft outside the 5° beam width wouldn't show up on the scope. Am I right in that theory?"

Wm. S. Parnell: "Yes, that's right. We are talking here of a symmetrical antenna reflector, and that would produce the same beam width in the horizontal and vertical planes."

Cole H. Morrow: "Can we assume that if an aircraft was outside of the 5° sector of the horizontal plane in front of you, that it would not show on the scope? That brings our altitude consideration down to a very narrow point."

Wm. S. Parnell: "You say 'narrow', but if another airplane is 5 miles away, it could be 1300 feet above or below your line of flight and it would appear on the indicator that you were flying a collision course."

Cole H. Morrow: "The point is that even in the 5°, there probably is a problem. We aren't talking about 90°."

Capt. J. D. Smith: "I think that gets us down to the meat of the problem right there. From an airline pilot's standpoint, if we were to receive information regarding a possible collision and it wasn't clear as to whether the probability was there, merely telling us that an airplane is in the immediate vicinity without altitude information, it's difficult to see what advantage we'd gain out of it. That gets us back to the point of the information confusing the issue."

Wm. S. Parnell: "The information could be clarified by means of an antenna tilt control either mechanical or electrical. If a 'pip' showed on the indicator, the pilot could easily detect whether the plane is above or below his line of flight by tilting the antenna. If the 'pip' disappears when the antenna is tilted down, it would mean that the other aircraft plane is flying above the present line of flight."

Capt. J. D. Smith: "Don't misunderstand my position on this. The first consideration of every pilot is avoiding a mid-air collision. In giving them the information, it should be done so that the pilot doesn't receive a false warning on his problem, particularly when

(Continued on page 50)

Facts and Figures!..

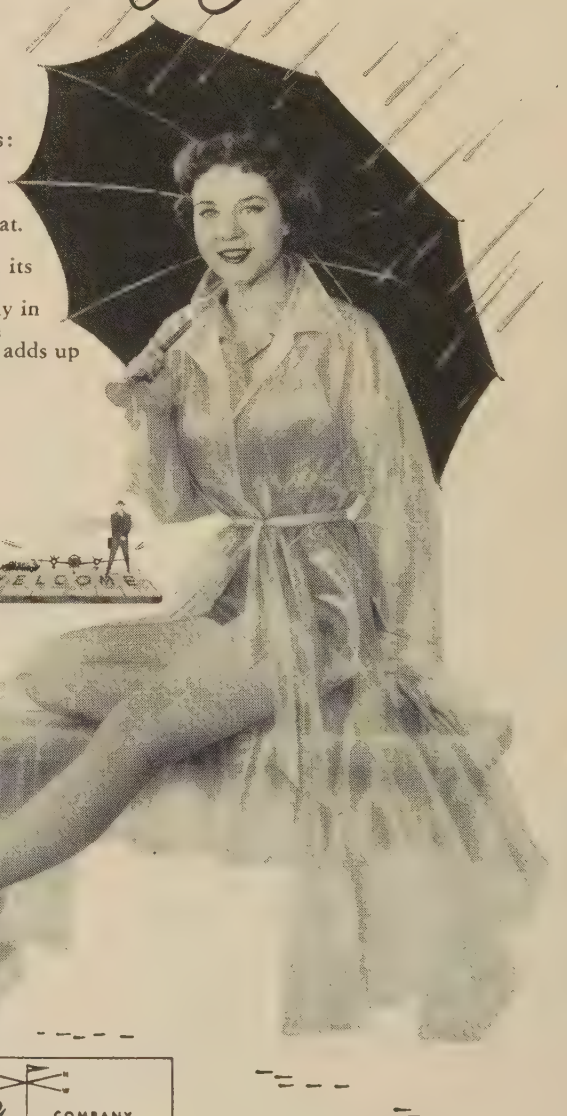

Figure:

Nancy Boyd's peek-a-boo April raincoat proves at least two points: Dallas rain falleth (if and when it falleth) gently and mistily like an angel's kiss, and Nancy Boyd looks great in a peek-a-boo raincoat. Also, since it has taken Southwest Airmotive 21 years to fully bloom its best, we can't for the life of us figure out how Nancy got so lovely in only 16 summers. She's 5' 4", with brown hair and brown eyes. It all adds up to 110 pretty pounds.

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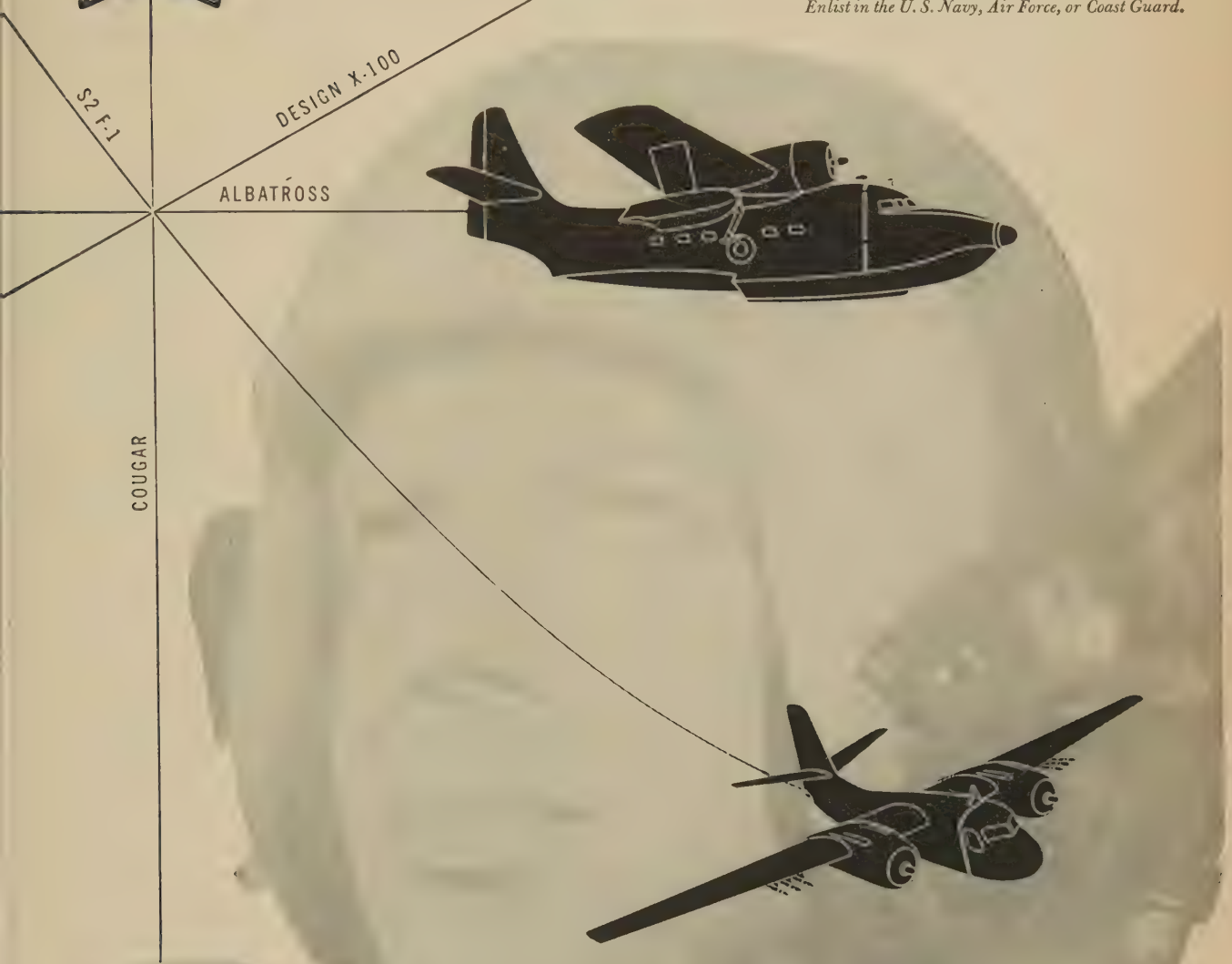

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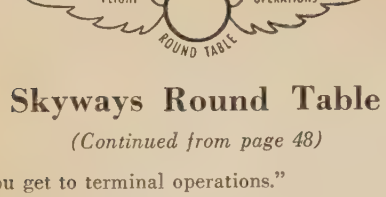


Skyways Round Table

(Continued from page 48)

you get to terminal operations."

Sam Saint: *"I'd like permission to express an opinion on this. An airborne radar, as we know it today, gives very little hope of doing a useful job on air-to-air collision problems. It might offer some slight advantage, but it is certainly not, in my opinion, the over-all answer to the air-to-air collision problem, particularly in congested terminal areas."*

W. T. Carnes, Jr.: "I was just wondering, Sam, why no one has brought up the possibility of putting airborne transponders in the airplanes. Someone usually points out that since we have a big program to get airborne transponders in our airplanes for ground surveillance radar, let's pick the same frequency and make those same transponders work with airborne radar.

"For the record I'd like to state that my comments regarding the incompatibility of airborne radar with ground radar beacons also apply to the problem of coordinating a system of airborne beacons to work with airborne radar."

Sam Saint: *"In other words, Bill, you don't give us much hope that we'll be able to put a radar beacon as a tail light on all aircraft flying, and have those beacons satisfactorily respond to the airborne radars which we may carry some day."*

Wm. T. Carnes, Jr.: "If you'll give us enough time, and I mean years to handle the necessary coordination, we'll give it to you. But you'll lose the use of radar during that period."

Sam Saint: *"To sum this up quickly, it appears there is very dim hope, indeed, of having such a program come into being."*

Cole H. Morrow: "To follow up on what Sam has just said and from the discussion we've had here, I conclude that the real advantage of airborne radar is in conjunction with weather; and that the other uses that radar might be put to are secondary by virtue of the technical difficulties of gathering the information and interpreting and using it. Mainly, airborne radar will have to make its way on its ability to provide weather information in the cockpit."

Sam Saint: *"The terrain-clearance feature of an airborne radar is a very close second to the weather-detection feature."*

Capt. R. D. Fordyce: "A third point might be its very limited use as a ground navigational aid, particularly for executive aircraft."

Cost and Weight

Sam Saint: *"Cole Morrow's very brief comment sums up the over-all operational use of airborne radar quite nicely. I think we ought to use the remaining few minutes to discuss the cost and weight factors of airborne radar.*

"Owen Lindley, can you give us some idea as to what sort of a beast we're talking about in terms of weight and cost?"

Owen K. Lindley: "To begin with, I think you're talking about two different beasts, depending on whether you're talking about 3.2 cm or something in the area of 5 to 6 cm. The value to be placed upon each unit as a sales price is governed by the frequency you go into. In other words, I think you'll get your 3.2 cm at a lesser cost per unit than you will the 5 to 6 cm at this particular phase of the radar design and development.

"If you insist on 5- to 6-cm equipment, you are probably talking about something in excess of $20,000."

Sam Saint: *"Does a higher price for the 5- to 6-cm equipment mean that it will weigh more also?"*

Owen K. Lindley: "No. I think some of the specifications are calling for weights not to exceed 150 pounds for complete systems."

Cole H. Morrow: "Are those the weights for both 3.2 cm and the 5 or 6 cm?"

Wrong Holding Pattern

The airliner finally had to go to an alternate airport, and it was not the only one that did. At breakfast the next morning several of the stewardesses were chatting together. "My captain missed two approaches last night," Sadie put in.

"Two approaches!" one of the girls exclaimed in astonishment, because with other airliners stacked up a pilot gets one try and then he has to high-tail it for he doesn't have enough fuel to hang around. "Two approaches!"

"Yeh," Sadie replied. "One at Chicago and one when we got to the hotel here."

Capt. Hy Sheridan

Owen K. Lindley: "Yes. A price differential would be based on engineering design and development. Bear in mind, now, that we're not talking in great potential when we speak of number of units. You're not comparing that with television or radio receivers. We're talking in a production of hundreds, not tens of thousands. The price will come down if there are orders for 500, as compared to 100."

Cole H. Morrow: "Do you have figures on space requirements?"

Owen K. Lindley: "Your antenna space requirement is more or less dictated. Considerations are being given to an antenna ranging anywhere from 18 inches diameter up to 30 inches diameter. Your receiver and transmitter will be rack-mounted."

Sam Saint: *"We've heard from time to time about simple radars that weigh a half or a third of the radar we've been talking about, and that cost a great deal less money. Do we dare to hope for a very simple solution to this problem?"*

Wm. T. Carnes, Jr.: "I think we can say that present-day radars as we know them are not too suitable for airline operations. The reaction of the airline technical people up to now has been that any radar to be suitable for airline use is going to have to be redesigned with an entirely different concept of reliability and with the airline type of operation in mind. That's the reason I take exception to what Mr. Lindley has stated, in that he is really comparing a present-day 3-cm radar against an airline type 6-cm radar, rather than recognizing that we would still want the redesign of a 3-cm radar to meet airline requirements."

Owen K. Lindley: "You're absolutely right Bill. We all realize that the present-day design of radar, as being used by the military is not applicable for commercial operations. My figures and weights were based on a complete redesign and development."

Sam Saint: *"I guess we can conclude that an airborne radar has certain valuable potential uses, but that there are problems between our present position and the day when we actually get radar into service."*

Wm. T. Carnes, Jr.: "I hate to leave this frequency matter up in the air without mentioning the reason why the airline technical people favor a change of frequency. Although it has been stated that use of a new frequency might increase the cost, we should note the fact that performance is the thing we're spending thousands of dollars for, and if we don't get performance, we might as well save our dollars in the first place.

"Aeronautical Radio and ATA have jointly placed a study contract with Dr. Marshall of McGill University in Montreal, and we've just received an advance copy of the report on the study. The report indicates that if we accept a 3-cm radar, the range is going to be seriously limited under conditions of intervening precipitation of not too high an intensity. But if we employ a 6-cm radar, the range is extended considerably under these conditions of intervening high-intensity precipitation. So, although we might pay more for a radar with the different frequency, we will be getting the maximum range out of the radar under the conditions for which the radar was designed to work. Remember that this is not navigational radar, this is weather avoidance radar. It stands to reason that we don't want the performance to deteriorate seriously under the conditions in which it was intended to be used. We, therefore, have to consider these points and choose the frequency on the basis of operational requirement rather than on the basis of cost alone."

Sam Saint: *"Well, gentlemen, it is time to bring this discussion to an end. I think that we have indicated in general terms how the various interests around this table feel about this complex bit of electronic machinery. Namely, that airborne radar's prime usefulness is in the detection of weather; that terrain clearance is a close second; and navigation is third.*

"I think that most of us feel that radar in the air is like radar on the ground. After considerable backing and filling we will put it to work. And after we have, we'll wonder how we ever got along without it.

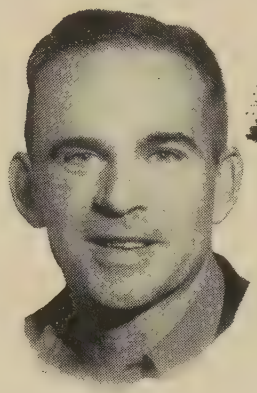
"I want to thank you all for coming, and I also want to thank Skyways *for making this platform available to us."*

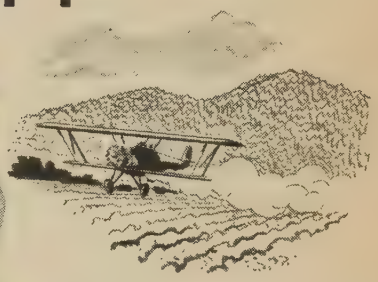
PLANE FAX

Case-history reports on performance tests with New RPM Aviation Oil!

Here's what western flight experts say about the new "RPM"!

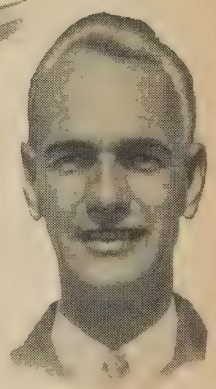
Ivor Witney of the San Francisco Sheriff's Air Squadron says: "In more than 24 years of flying, I have found no other iation oil to compare with the new 'RPM.' Tests over a -month period show it gave lower oil temperatures, and my ht plane engine ran smoother than ever before."





J. L. Rich, President of Farm-Air, Inc., of West Sacramento, California, reports: "The new 'RPM,' tested in our aircraft used for crop dusting, ended our trouble with sticking rings and valves, reduced lay-up time. Inspection proved the engines stayed clean through the season. All our aircraft now use the new 'RPM'."

L. Sharp, Manager of Gardena lley Airport, Inc., Gardena, Cal-rnia, says: "Our tests show that e new 'RPM' proved to be the st aviation oil we've ever used—th from the standpoint of keep-g the engine clean and a mini-um of engine wear after 1300 flying hours."



Wally Thompson, owner of Thompson Aviation, at Sonoma County Airport, Santa Rosa, California, says: "We've been using the new 'RPM' in three of our aircraft for over 15 months. Our experience with the new 'RPM' shows lower oil consumption and temperature, cleaner engines and non-fouling of plugs and elimination of detonation and pre-ignition."

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On-The-Spot Arrivals

(Continued from page 13)

good passenger connections from anywhere to anywhere else is not difficult if you have all of the airliners come in and go out at the same time. This is ideal, but like so many ideal things, it sure has a hard time in this practical and imperfect world. A racket called physics says that two objects cannot occupy the same place at the same time, and anyone who endeavors to bring such a condition about, especially with a couple of airliners, is likely to be disappointed. Our pilots were quite ready to accept this precept on the recommendation of the sages who seem to have most of their affairs with calculus and unscented things like that.

Let us say that the scene is Chicago, although it might be any other large city, for our modest author is more used to having the Regulations scared out of him there than at other centers of population, for that is his base, and thus he can depend upon his memory rather than upon his imagination.

When our pilots had reached a town about 40 miles out, the "in-range" check point, they tried to call up the bird in the tower and tell him to steel himself. They couldn't, though. They couldn't break in on the flow of jabber, for the tower was talking to about 14 other airplanes at the same time. And because it is so hard to break in to report position, a very bad condition has come up—a condition that annoys the tower chappie no end, for when a pilot finds a slight break in the staccato verbosity he jams down on his mike button and says something like, "Untied Airlines 2751 coming up on Oopsville."

Now, they have been "coming up on" Oopsville ever since they left New York and a report like that doesn't give the bird in the tower much of a chance to figure out where the airliner really is and he can hardly plan on the sequence of the arrivals at a landing approach position. And because "coming up on" may give one pilot unfair precedence over some other pilot, or the latter thinks that it does, some of the pilots in self-defense have stretched out the "position" until it has hardly any more meaning than a Russian treaty.

So, when our two heroes got close to the field, the bird in the glass cage picked up their lights and he asked, "That you, American 158? Whyn't you report?" But before our heroes could reply, the rattle of words was on again. And the squeals, for when two mike buttons are down at the same time the two carrier waves mix and it sounds like Errol Flynn had just stepped into a Wac barracks. Here is how it all sounded.

"Chicago Tower, this is . . . no, no, no, 22 left . . . that's right . . . you say left? . . . right . . . no, no, pull up, Delta 1121 is landing on the right . . . who pull up? me? . . . no, Eastern 8351 cleared to land on 22 right . . . who's coming into 22 right? . . . squeal squeal . . . roger . . . where are you Capital 4474? . . . we are over Paxituny and 107th streets . . . roger, Capital 4474 you are number seven to approach . . . no, I'm not Capital 4474 that's the other fellow, I'm Chicago and Southern 2115 . . . no, not fifty, fifteen . . . United 2786 you are number six to land follow American 158 . . . where is American . . . squeal squeal squeal . . . there are two planes just above you and behind and three coming in on the right do you see 'em? . . ."

Our captain looks at the first officer. "Do you suppose he meant that for us?"

"Might be."

"Do you see anybody on your side?"

"No."

"Anyway, we must be right among 'em." The two pilots begin to bounce around in the cockpit. It looks like they were dodging rifle fire but they are not. They are just trying to see.

The modern airliner, as you throttle-pushers know, is over 95% blind in perfectly clear weather. Airliners can close together from any direction in the three dimensions.

You can't see another airliner above you or below, or behind, or to the sides, in most positions. This is not a condition that soothes the flyers. When airliners are scooting around, even when slowed around airports to 170 mph, if they are pointed toward each other they will close in at the rate of 510 feet a second. An airliner can be out of sight one moment, a mile away, and be hitting you in 10 seconds.

The Airy Touch

You'll never hear an airline pilot say that he's under the weather. That's where he wants to be. Everyone else wants to get up in the world, but his main problem is how to get down.

Capt. Hy Sheridan

And it is mighty hard to see navigation lights against the lights of a city. What makes the situation even more curdled is that, even if your airliner wasn't a flying blind-angel, the various airliners are changing positions in all directions including up and down so that a fellow simply cannot keep his eye on them all. Now you see him, now you don't.

And the news has gotten around that the airline managers frown upon having their flying machines flop into the ground and get all wrinkled up, and so the pilots have come to admire the habit of paying some attention to the job of flying their own airliner and looking to see what obstructions they may be running into and to an inspection of the instruments, and you cannot concentrate on all of that and be screwing your eyes all over local creation at the same time.

But let us get back to our heroes.

Our doughty captain says, "Where is United 2736? Weren't we supposed to follow United 2736?"

"Naw," the first officer replies, "that was United 2763 we are supposed to follow."

This snide remark is a bit of cockpit humor. You see, the airliners do not carry huge illuminated signs on their sides visible a mile away that say: "THIS IS UNITED FLIGHT 2736." How, then, can the pilots know which flight is which? They can't. They have to guess. Often they guess wrong. Why, then, does the tower chappie tell the pilots to do this? I am not going to answer that question for I might hurt someone's feelings and I would not want to do that for the world, for I reek with sweetness inside.

Suppose our heroes see the navigation lights of another hopeful and they think, "Ah, that is United 2736," but it isn't; it's really Trans Cosmos 5959. But our heroes do not know that. United 2736 has been instructed to follow Trans Cosmos 5959 and the United fellow guessed right and he is swinging in behind the Trans Cosmos tin bird, but our heroes guessed wrong and they are swinging in behind the same airliner.

Here is a good place to mention something that often is highly entertaining and helps to remove boredom from the vicinity of airline pilots. When a big airliner banks to turn, the cockpit roof slides over and the pilots cannot see where they are going. What do the pilots do? They do at this juncture what they must do in general airline practice—they turn on their hopers and hope for the best, and at the same time they thank the good Lord for putting so much space into three dimensions.

Our heroes each are staging what looks like a one-man wrestling show, tieing themselves in knots trying to get into a position to see out.

"My heavens," the captain shouts, "what was that that went bustin' by?"

"Don't know who he was," the first officer replies, "but he went by. I like to have 'em go by. I don't know where he came from. I didn't see him at all." At this moment the first officer becomes thoughtful, showing that he is a fairly new man because after a fellow has been flying airliners for a considerable time he has learned to give up such conceits. The first officer's face takes on a look of thoughtfulness and he breathes, "Boy, I sure feel temporary."

The poor bird in the glass cage doesn't know which airliner is which, any more than the pilots do, yet he is expected to keep them sorted out and to have a good alibi handy if he doesn't. He has to talk mighty fast, and how they keep things as straight as they do amazes me. They are superhuman but they have to be super superhuman and they are not that.

"American 27, do you see Delta 1748 and Eastern 27 and C&S 2848 on your right? Are you burning a landing light. Who? United 1784 is. Widen your turn and follow Northwest 4828. No, American, not Delta. You are number 5 to approach. Braniff 2771, turn off on 36 right and taxi north. Who is that approaching 22 right? Oh, I told you to follow Northwest 4848, you must be following East & West 1756. No, you are cleared to land on 22leftgoaround2748notyoucontinueapproach1784donotcross2211left squealsquealflashlightssixteenfiftysixpullup . . ."

This sort of thing can give the public the impression that we do not know what we are doing. Of course, we do not know what we are doing, but we do not wish the public to get that impression. Out of the bustle comes the bust, to quote an old proverb.

(Continued on page 54)

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Time was when the man who traveled for a living enjoyed precious few hours of home life. But that, of course, was before air travel came of age and TWA had a chance to become such a good family friend. Nowadays, the traveling businessman is rarely separated by more than a few pleasant Constellation Skyliner hours from those he holds near and dear. And the same convenient TWA schedules that let him start later and arrive fresher at his distant point of call help him get home oftener and earlier as well.

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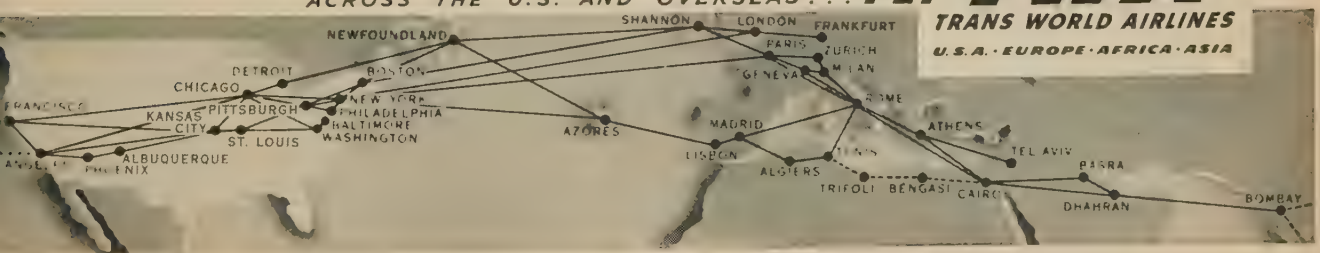

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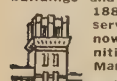

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On-The-Spot Arrivals

(Continued from page 52)

There must be some simple way, some common sense way, of getting airliners in quickly and safely in good weather.

There is and this is it. It's called the On-the-Spot System. Because the plan is composed of common sense and very little of that, as Sadie puts it, the method probably will meet with a great deal of resistance.

The On the Spot System

The Spot way is proposed for good weather, not for bad weather. The reason that the regular blind approach system, such as GCA or ILS, is not used in good weather is because it would slow down arrivals and make for delays. Everyone is familiar with airliners being stacked up. *(This has nothing to do with stewardesses.*—Ed.)

Any ideal good-weather method should provide the following:

1. No danger of collision.
2. No need for any pilot to try and pick out and identify any other airliner.
3. No need for any pilot to follow any other airplane.
4. No need for a pilot to ask where the other "traffic" is.
5. Radio reports to the tower cut down to no more than three or four standard sentences.
6. Radio instructions from the tower cut down to about two sentences.
7. Each pilot will know where all the other airplanes are, but he will not care, for he has no need to consider them.
8. When he is cleared to land, he will know that his approach path is clear of other airplanes and he can do a job of safe approaching and landing.
9. The tower man will know just where each airplane is, without asking and without a chance for a mistake.
10. The chance for a misunderstanding is almost wholly removed.
11. Arrivals in good weather will be speeded up—the swarm method now used causes uncertainty on the part of tower men and pilots alike and that means delay. It means that pilots must swing wide, must take the time to be fairly safe—for the ideal method will space the airliners just right so that they can come in, one after the other, as closely as the landings and roll-outs permit.
12. Safety in the air, safety on the landings, will be much improved.

These goals are fulfilled by the Spot System. Here's how it works.

Spot System in Action

American 158 gets to Joliet and reports to the tower. The purpose of this report is to get on the tower man's list. American 158 then automatically proceeds to Argo. That is his Spot. That is the automatic Spot of all planes coming in from the southwest and the west. This is a Spot that is close to the airport and it is easy to see and it has been used as a check point for years and every pilot on the regular run knows it well.

The tower man knows how long it is going to take for American 158 to get from Joliet to Argo. When the pilot gets to Argo, he does not have to report his arrival. If the way is clear for American 158 to approach for a landing, the tower man will say, "American 158, clear to land on 22 left."

Note how the radio jabber has been cut down. The pilot reported over Joliet and the tower man acknowledged it. Then the tower man cleared the airliner to land. That was all. Cutting down on the jabber is important, for the more jabber the more chance there is for misunderstandings. With the Spot System, in case an emergency arises, the pilot in trouble can get through because the radio channel is not messed up.

Suppose that a lot of airliners are converging upon Chicago from all directions. In any case they have to await their own turns to land. When they swarm in, there is a mess which slows everything up. But they are now going to be spaced in definite time segments and in a definite order. So American, in this case, is going to have to hold a bit. He knows that he is going to have to hold at Argo, if he is not cleared to land. Automatically, he holds at Argo. Perhaps there is another plane ahead of him holding at Argo, and this plane will be at the lowest holding altitude of 2500 feet. In this case the tower man will usually tell American 158 to hold at the next higher level, 3500 feet. The two pilots can see each other's airliner; they know where to look. So can the tower man. All of the Spots are within easy eyeshot of the tower.

When the man at 2500 feet over Argo has been cleared to approach, American 158 will know it, will hear the instructions, and will normally go down to hold at 2500 feet himself. He can watch the other airliner leave the Spot and so can the bird in the glass cage.

The spacing can be done with the best precision yet achieved in aviation. The tower man, for example, knows just how long, almost to the second, it takes for an airliner to approach and land from Argo on any of the runways, and he also knows this for all of the other close-in Spots.

Northwest is holding at the Maywood tank or perhaps a closer Spot. The bird in the glass cage knows almost to the second how long it is going to take Northwest to touchdown and just how long it will take American. He can time his instructions to approach for the landing and this is the only way that he can do it. The result is safety and the saving of time.

You see, each airway will have its own Spot. A pilot coming in on Pink 5 will know his Spot and so will the tower. Thus the planes are sorted out and put in order.

The Spot System, or something like it, will save time, money, lives, and nervous system. Up to now, the situation has been a hit or miss affair, and that is no idiom, sir.

I mentioned the idea to a certain official who replied, using the usual knotted officialese verbiage which I will translate for you, "Aw shucks, you want to take all of the fun out of things."

Well, I have to go now. I'll be running into you. What am I saying?

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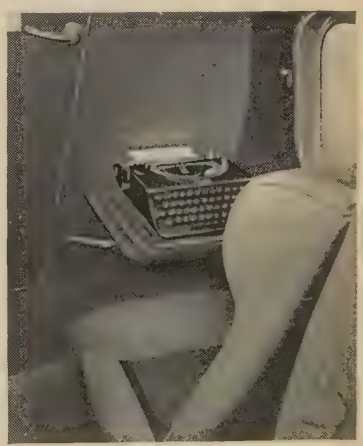

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Twin Bonanza

(Continued from page 12)

beefing up the structure to enhance the safety factor, the designers had to accept a realistic total useful load figure.

The airplane has two cargo compartments, one behind the rear seat and one in the nose. The rear compartment is placarded at 200 lbs., and the forward compartment at 100 lbs. The door of the rear compartment is just behind the right wing and measures 26½ inches by 26¾ inches. The rear seat of the plane can be removed and much of the loading can be accomplished through the rear compartment door. The front cargo section door, which swings out toward the starboard engine, is equipped with a safety switch and neither engine can be started until that door is closed and locked.

Forward visibility of the *Twin-Bonanza* is excellent. However, the low wing and the position of the engine nacelles cut visibility in other directions and this is especially noticeable while you are in the traffic pattern.

The position of the propeller circuit breakers, to the right and at a low level on the instrument panel, is not convenient to the pilot. They should be over on the left side and I am informed that the shift is being made.

In the realm of performance, the *Twin-Bonanza* is good. I flew No. 3 airplane, owned by Spencer-Lycoming division of AVCO.

Although we did not fly at maximum gross, we took off like a scared rabbit and reached safe single-engine airspeed—90 mph—in a minimum of time. Each of the Lycomings delivers 260 hp at 3400 rpm for take-off and in this airplane, as in others carrying them, there should be no hesitation in using the full rating. You can always count on the Lycomings to really deliver within placarded limits on take-off. The efficiency of this powerplant is increased with the installation of jet augmentation, which uses the heat and velocity of exhaust gases for additional thrust.

The climb performance is not the best yet attained with comparable airplanes, but it is good. At normal rated power and maximum gross weight, the *Twin-Bonanza* will climb at the rate of 1450-plus fpm or about 110 mph. Its single-engine rate of climb with a windmilling propeller is 210 fpm, and with a feathered prop it is 310 fpm. The plane's service ceiling is an acceptable 19,000 ft. That figure probably will be materially increased because, it is my understanding, Lycoming is now at work on a supercharged version of the GO435-C2 engine for *Twin-Bonanza* installation and for other aircraft.

The *Twin-Bonanza* has good inherent stall warning, particularly in power-on stalls, and is equipped with a warning indicator set slightly above the stall. To complete that picture, the plane has a high stalling angle. I found, too, that aileron control is effective when the wing is stalled and that directional control can be held by rudder. It will stall out at around 65 mph with flaps and gear extended, and at about 75 mph clean.

An important factor in the *Twin-Bonanza's* performance is the propeller. Standard equipment on this airplane are two Beech B200-16 constant-speed propellers. But for improved single-engine performance, full-feathering versions of this excellent prop are available. The propellers on the *Twin-Bonanza* use the hub, pitch-change device and blade configuration designed for the *Bonanza.*

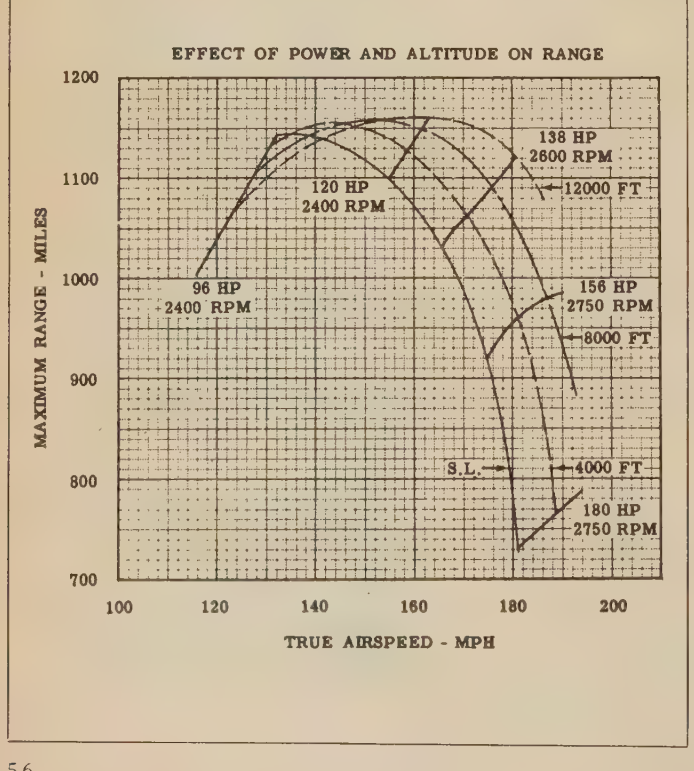
This propeller installation warrants description. On the console the pilot will find levers which permit him to select any desired rpm. A mechanical linkage to the hydraulic prop governors increases or decreases pitch as required and, when an engine fails, the dead engine prop can be placed in full high pitch by moving the prop lever aft. On the feathering propeller, inadvertent feathering is prevented by a detent at the high-pitch end of the constant-speed range.

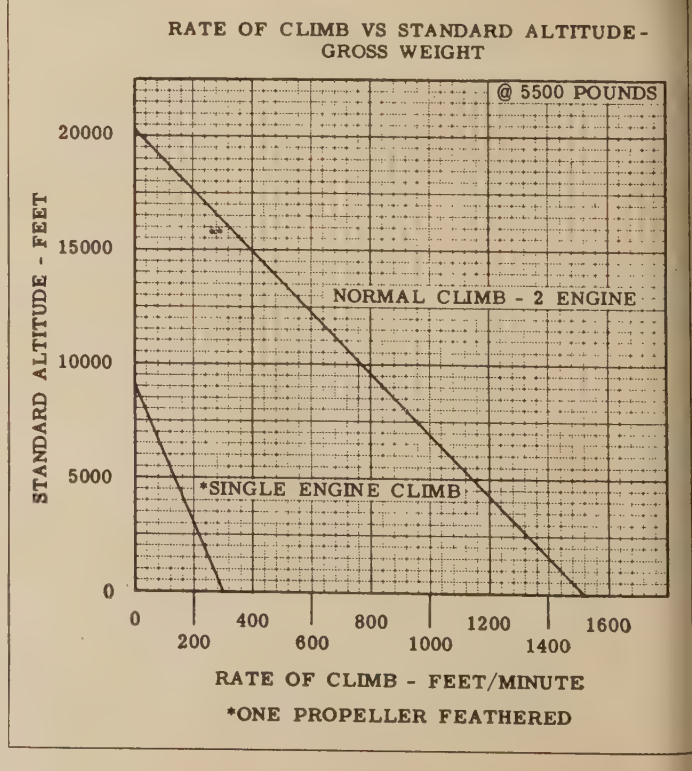
To unfeather, the pilot moves the lever forward past the detent. Governor oil pressure and an electric motor supply power for the feathering operation. The motor continues operating until the propeller reaches the full-feathered position, 84°.

I also liked the landing gear indicator. The gear position lights are on the instrument panel under the landing gear switch, showing red when the gear is retracted and green when it is down and locked. There also is a mechanical position indicator, which is linked to the nose wheel. It is on top of the nose-wheel well in the floor of the cabin and shows "DN" when the gear is fully extended and "UP" when it is fully retracted. That indicator has a light which is on when the master switch is on. There also is a warning horn when wheels are not down and locked and when the gear switch is moved to the "UP" position when the plane is on the ground. A clutch lever below the copilot's seat is available for manual operation.

Beech devoted much thought and planning to the instrument panel and, except for the hard-to-reach prop circuit breaker switches, it is a good design. The panel is tilted 10° to facilitate instrument reading, and all dial markings have a flourescent coating for night operation. Most instruments are marked to show normal operating range, limitations.

The *Twin-Bonanza* is a rugged airplane with in-built safety features which will be very attractive to civilian users in their search for a new light twin to replace present equipment or to augment a fleet.





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U.S. AIR FORCE

Data Presentation

(Continued from page 18)

there are too many different denominations involved in present measuring techniques for the pilot to remember. If we have qualitative information in an adequate form, we don't need the quantity. The fewer numbers the pilot has to remember, the fewer chances he has of making an error. There are many instances where pilots have read the airspeed for the altimeter, the oil pressure for oil temperature, etc. One incident which comes to mind is an experience in which the pilot was steering a heading of 150° with the cylinder head temperature reading 180°. After some time the pilot found himself steering 180° and worrying about the 30° drop in cylinder head temperature. Fortunately the error was discovered in time. Optical illusions are quite common. The fact that these mistakes are made by pilots is the problem at hand and the situation could be improved by reducing the number of numerical values on instrument dials. The example cited above would never have occurred if the cylinder head temperature had been marked normal, high or low because only the degrees of heading would have been apparent to the pilot.

There are certain indications which must be shown by actual quantities. Such indications can be established by determining whether or not they are used as a factor in some general flight equation. The airspeed, for example, must be a numerical value because it is essential to solving the navigation and fuel consumption problem. As an approach instrument, however, the actual quantity is used only as an index. Approach speed is determined by pilot handbooks, discussion with other pilots, and actual flight test. The value will vary with gross weight of the aircraft and the pilot's personal feelings about how slow he wants to come in. At any rate, once a figure is established by the pilot it becomes an index which he uses in making all approaches to the field.

The point of eliminating numbers on an airspeed indicator is a very touchy subject with most pilots and will not be stressed. It is quite open for debate but it is still safe to say that the number itself in the lower ranges is still only an index. No pilot will object to an attempt to simplify his problem, and at least some progress would be made by the elimination of some of the superfluous numbers on present instruments. Such a modification would reduce the amount of information required for retention by the pilot. It would require less actual reading of the instruments in flight, thus permitting more time for concentration on primary problems.

Check-outs in different types of aircraft would be easier and would require less effort on the part of the pilot. Actually there would be no requirement for memorizing any specific value because the numbers presented would only be airspeed, altitude, heading, and fuel quantity. These are the quantities we must have, the others are redundant. One of the rules in solving any complicated problem is to reduce it to its simplest terms. Why not apply this to the instrument panel?

The opinions or assertions contained herein are the private ones of the author and are not to be construed as official or reflecting the views of the Navy Department.

Transport Trends

(Continued from page 17)

its relationship to the occupants of the airplane, but as it exists between the powerplants and equipment on or in the vicinity of the ground and the people on the ground. The problem is being tackled on many fronts, and practical improvements have already been made in the nature of operational controls as to directions and altitudes of take-offs, climb-outs, approaches and landings. Also, baffles and directional reflectors and absorbers are coming into use to control some fixed ground run-up problems. However, it has become quite evident that the problem is not strictly one of noise, but has substantial elements of individual and mass reactions to fear and various annoyances. People have indicated their great concern about noise and low flying in general, and have registered innumerable complaints of interruption of sleep, fear of crashes, annoying vibrations and rattling of dishes, interruptions of radio and TV programs, interruptions of telephone conversations and concern about frightened children. We certainly cannot deny the existence of this most serious problem. While we are gravely concerned about the generation (with large reciprocating engines) of over-all maximum sound intensities of 100 to 105 db, and with conventional propellers of 115 to 120 db, we must look forward with even greater concern to sound intensities approaching 130 db with supersonic propellers, and 125 db with unaugmented turbojets, rising to perhaps 140 db with afterburners. These values are well beyond acceptable levels and threaten to reach proportions that we cannot hope to control satisfactorily by the simple expedient of operational restrictions. It is absurd to suggest that a reasonable solution would be the relocation of airports or time limitations on their use. The penalties and depreciation of military and commercial values attendant on such a solution would work a totally unjustifiable disservice to the national interest. We must, therefore, consider the problem one of the most difficult but inspiring challenges which have been thrown at the scientists, engineers and operators of the country.

Turbojet Performance

Our somewhat larger, longer range, high-altitude, high-speed transports must be injected into the increasingly crowded traffic patterns at existing airports. Obviously, such aircraft will find their primary use in connection with the larger centers of population, and the runway lengths available do not seem to present any problem with respect to take-off, but they do with respect to accelerate-stop distance. Power required to achieve the high-speed performances and the relatively low wing loadings required for efficient operation at the high altitudes, would appear to give very adequate unaugmented take-off characteristics. There is, of course, some question of variations of take-off performance with temperature, but with reasonable accountability, this does not appear serious. On the other hand, we must examine most carefully the aircraft performance during approach and landing. It would be most desirable if all aircraft could have a wide latitude of satisfactory approach and climb-out speeds, such that maximum consistency and good flexibility of operation would be available during the approach and climb regimes to accommodate at any given airport or on any given runway a maximum traffic frequency. If this cannot be accomplished, the situation will, of course, be largely dependent upon the aircraft having the highest required approach speed and the aircraft having the lowest climb speed. Presumably, all other aircraft could, if necessary, speed up their approaches within reason or, with sacrifices of efficiency, decrease their climb speeds for maximum traffic capacity. Anticipating a fully satisfactory climb performance for our future transport, we must then look to a satisfactorily low approach speed and adequate control to insure airport efficiency. The existing requirement of approximately 10% residual thrust on approach to provide prompt acceleration, if needed, gives us a difficult problem.

The other portion of this problem is, of course, the landing deceleration. With a clean jet-type airplane without reverse thrust provisions, we are very dependent on a super efficient landing technique and the existence of very satisfactory runway characteristics and airplane braking qualities. We can, of course, look to dive brakes and other high drag devices for aerodynamic deceleration during the initial landing run. We might even look to drag chutes for such assistance on emergency fields, or in cases of slippery runways or over-shoots. However, the effectiveness of such devices diminishes with loss of speed, and they cannot be considered the equivalent of a reverse-thrust producing mechanism for landing safely under all conditions.

Also in the field of operation, we must look forward with increasing concern to the possibilities of collision with terrain or with other aircraft as well as the adverse effects of rain, hail and turbulence. We cannot deny that increased speeds make these problems more difficult, and the adverse effects more important to avoid. "The see and be seen" principle is already obsolescent in consideration of increasing speeds and air traffic densities in the vicinity of major terminals. The interim provision of high intensity flashing lights to help in the air-to-air collision problem is, of course, a worthwhile contribution. But, as speeds and traffic densities further increase, such devices do not alleviate the confusion

(Continued on page 61)

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Transport Trends

(Continued from page 58)

or help solve the problem. It is evident that atisfactory airborne radar can be very beneficial as a defense against terrain collision, an function as a supplementary navigational levice, and can help greatly to avoid the high urbulence associated with thunderstorms. As et, however, we have no answers, except the neteorological approaches, to the complete voidance of hail or clear air turbulence, nor an radar be considered a satisfactory device or the prevention of air-to-air collisions, due o the rapidity of the relative motions and he confusion of the information presented in his instance. It would seem that the solution o this problem lies in the area of more precisely controlled flight paths and patterns vith the hoped-for development of cockpit ndications and warnings possibly operated n the Doppler principle.

urbojet Operation Problems

It seems obvious that the faster airplanes nd higher rates of descent to be employed in he future will allow the pilot less time to rim and adjust his airplane for touch-down. Ie must start to prepare for his landing furher back than is currently the case, and the peration would seem to require a relatively ong, straight-in approach. It seems essential hat approach performances be given the widst flexibility, or be held to values very close o those currently used. We must visualize a long period of time during which aircraft of conventional types will co-mingle with an increasing number of high-speed transports in traffic patterns and airport use. These problems directly affect airport utilization and traffic control techniques, both as to efficiency and safety.

We have mentioned the jet-transport deceleration problem. I would like to stress a few other safety problems associated with the turbo-type powerplant. One, of course, is the possibility of mechanical failure, particularly serious with turbine wheels which, with the tremendous amount of kinetic energy involved, release high destructive forces. This problem can be approached from the material and design angle providing adequate strength, reinforced by cooling, and satisfactory inspection methods to hopefully insure against failure. Another approach is to admit that failures may occur from time to time and to protect against their potentially serious results by powerplant arrangement and location, or by protective shielding.

Another serious turbo safety problem is that which involves continued rotation and the existence of extensive internal hot parts in the event of a crash landing. Possible rupture of fuel tanks or lines, even with—or perhaps, particularly with—low volatility fuel, demands very adequate fire protection and possibly rapid cooling methods.

We may also have problems associated with the altitude limits of combustion and with relighting in case of jet extinguishment. Mention has been made of the susceptibility of jet-type engines to serious internal damage from intake ice formations and from the ingestion of foreign objects. It is also essential that the acceleration of jet engines in case of required go around on landing be made rapid and dependable. This must be accomplished without invoking surge and without having to retain a too high percentage of RPM and thrust on approach with its aggravation of the landing deceleration problem.

A safety problem associated with noise, or more particularly with the prevalence of structural vibrations associated with jet exhaust, is the increasing frequency of structural failures due to fatigue from that cause. The areas most commonly affected are those directly subjected to the jet flow impulses. However, there has been an increasing indication of other critical failures attributable to high-frequency vibrations originating from the jet characteristics. It is to be hoped that the eventual solutions will decrease or eliminate the noise and structural failures, and will promote thrust efficiency.

Built-in Safety

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(Continued on page 64)

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Transport Trends

(Continued from page 61)

The cockpit must become the center of relaxed, efficient functioning. To this end, it must be adequately roomy and comfortable, well lighted, well heated, well ventilated, provided with fully adequate vision, must have a minimum but adequate number of easily operable controls, and readily identifiable and readable indications. The cockpit must be an efficient office. It must have a place for everything, and everything must be in its place. A study of the problem will, I am sure, convince you of the tremendous opportunities for improvement.

We must emphasize the improvement of air-transport fire protection. It has been unfortunately true that many powerplant fires have not been detected by the units installed for that purpose. In almost 50% of the cases with which I am familiar, attention was called to the existence of danger by passengers, cabin or cockpit crew, or engine malfunctioning rather than by operation of the fire-warning equipment. This has been due to improper location of detectors, deficient mounting of detectors on materials which failed easily or burned away before detector operation, and sometimes by destruction of detector circuits by fire before the warning was given. There is great need for determination by actual air flow tests, of the proper location of detector units and extinguisher outlets under all continuous operating conditions, including the opening and closing of any shutters which may affect air flow in the compartment under consideration.

One of the currently popular subjects for discussion in the safety field is whether or not seats should be faced forward, backward or sideways. It is obvious that turning our existing seats to the rear would provide no more, if as much, safety than at present. We have not yet analyzed exactly what it takes to determine the relative safety of the several seat directions. Dynamic load studies are required. We have previously suggested that the approach to the problem of accident survival should be based on the known loads which the human body, properly supported, can tolerate. This thinking carried along in the design of seats to face in any direction can, I believe, develop equivalent safety in all directions and eliminate this rather futile debate from our list. I would suggest that any action or regulation which limits the direction of seat facing in transport aircraft would be premature and ill advised.

Efficiency and Economy

There are a whole series of jet powerplant problems yet to be resolved in the area concerned primarily with efficiency and economy. One is the extremely adverse effects of high temperature and humidity on jet output. The question involved is, of course, one of temperature accountability. It would appear that the objective to be sought would be the achievement of a principle of temperature accountability which would produce the same adequacy of reserve performance encompassed in the present 50% temperature accountability with reciprocating engines. Full temperature accountability would, of course, maintain under all temperature conditions the full reserves for ideal conditions stated in the Civil Air Regulations, including the normal 50-foot obstacle clearance. At the other end of the list, no temperature accountability would normally result in the loss of the entire 50-foot margin at a temperature of approxi- of the list, no temperature accountability retains a percentage of the total margin all the way to 120°F. This is believed to be a very satisfactory and sensible compromise, and its retention in principle is recommended for future jet operations.

Another important jet efficiency problem is that associated with specific fuel consumptions. It appears now that we can hope, at some time in the future, for fuel consumptions per hour per pound of sea level thrust approximately twice those to be anticipated per equivalent horsepower hour with improved turboprop powerplants, or with the latest reciprocating compound engines. We are far from achieving such jet consumption values at the present time.

We must also determine and evaluate the effects of nozzle shape and adjustment and techniques of powerplant operation affecting cruising efficiency. We are faced with a serious problem in the relatively high fuel consumptions for taxiing operations. And, here we meet some airport problems. Consideration must be given to possible damage to runways and run-up areas due to blast, heat and fuel spillage. These effects are influenced by the character and materials of pavement construction, and by the proximity and direction of the jet exhausts relative to the ground. Augmented take-offs would greatly aggravate these problems. Taxi strips and holding areas must be designed to permit high taxiing speeds to conserve fuel, and to minimize taxiing distances. Aprons and airplane loading areas must give protection against blast and heat to structures, equipment and personnel, and must adequately control objectionable noise.

We must examine very closely the nature and costs of fuels to be used in commercial operations. Current jet-fuel specifications are based largely on maximum availability with satisfactory characteristics which may or may not produce the same answer as a satisfactory fuel of minimum cost. Turbo engines can be developed to operate satisfactorily and efficiently on a wide variety of fuels. Fuel costs are such a large percentage of jet operations that this economic factor must not be neglected.

An important consideration in realistic economic studies is the adequacy of assumptions of operational fuel reserves. A tentative suggestion which has been discussed with some of the aircraft and powerplant manufacturers is to assume a 45-minute weather hold at 20,000 feet at destination, followed by a descent to attempted landing, then a climb-out to 20,000 feet, and a cruise to alternate of 300 miles, followed by an additional hold of 45 minutes and descent to landing. This would appear to be a fairly drastic reserv requirement, but is not incompatible wit operational requirements under extremel adverse weather conditions. It appears tha with axial-flow engines of modern desig there is little difference in the fuel consump tion ratios of four- and two-engine holdin and—quite differently from *Comet-Ghost* e perience—no particular penalty is paid.

It is hoped that research may disclose sa isfactory methods for determining the exis ence of internal jet powerplant conditio which are signs of progressive deteriorati With the manifold opportunities for interna troubles in multi-stage axial compressors an turbines, and in view of the tremendous e pense involved in unnecessary removals an overhauls, it would be of immense benefit t jet economics if methods can be determine for detecting and forestalling serious trouble

Much additional information must be ob tained to establish the most efficient jet op erating altitudes. It seems a reasonable co clusion, based on recognizable limitations an relations of wing loadings, speeds and powe plant characteristics, that the probable alt tude range of efficient jet-transport oper tions will lie between 30,000 and 55,00 feet. Once 30,000 feet operating altitude exceeded—and exceed it we must for jet op erations—the problems are largely ones degree, not of nature. We must have absolu assurance of no decompression failures. Unt recently much thought was given to antic pated commercial jet operations to approx mately 40,000 feet, but more recent inform tion has indicated that this may be a som what undesirable altitude, at the approxima base of the tropopause, with prevalent turb lence and high-wind conditions. It would a pear, therefore, that jet-transport operatio may often be conducted at altitudes som what in excess of this, and that for the r tention of a reasonable bracket of efficien factors, they should not frequently be t much lower, although 30,000 feet may ofte prove necessary and desirable. It has al become apparent that at the higher altitud jet-stream velocities must be reckoned wi and avoided if they are in an unfavorable d rection, and that the boundaries of such j streams must be crossed in the shortest tim to minimize the turbulence.

We have tried to show that from the d versified air-transport equipment of 25 yea ago, there has emerged a simple and co sistent type varying principally in siz capacity, arrangement and performanc There are some significant changes indicate in the airplanes themselves, involving r finements of aerodynamic cleanness and for and substantial extensions in speed, altitud and associated performances, equipment a requirements. We must never forget th effective speed is of the essence in air trav and in spite of possible economic proble and technical difficulties, the availability that speed with adequate safety, depend bility and comfort will find extensive use the essential advances of this country.

Adapted from IAS Wright Brothers lectu